SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

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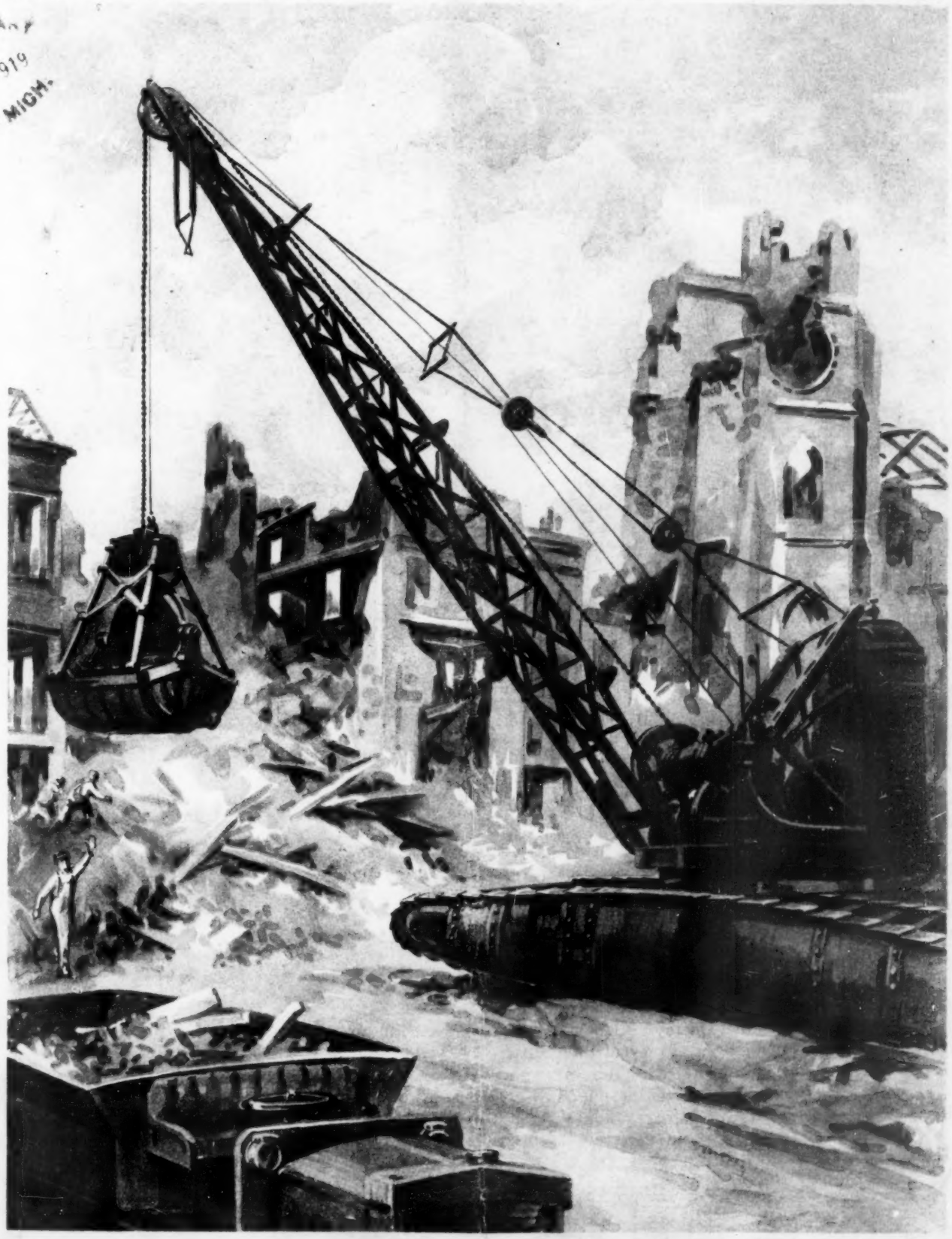

IN PEACE TIME DRESS: MODIFIED TANK AT WORK IN DEVASTATED FRANCE—[See page 55]

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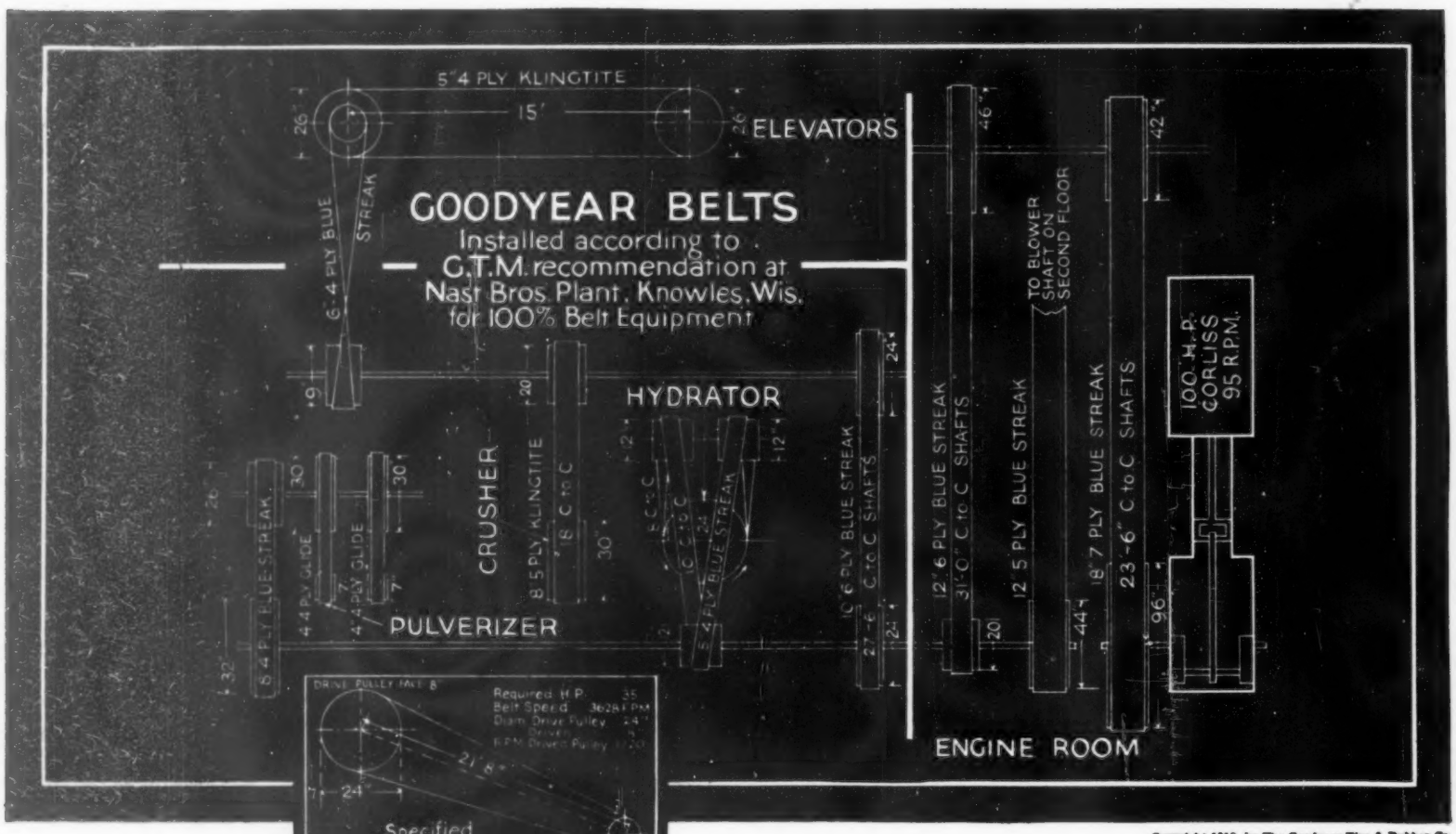

Copyright 1919, by The Goodyear Tire & Rubber Co.

One Belt, an Entire Plant—and the G. T. M.

It all began with a belt-killer—the pulverizer drive. Belts, with good luck, sometimes lasted a year on it. Even then, their short lives were full of trouble; for they stretched, jumped the pulleys, gaped at the plies. Then one day about two years ago, the G. T. M.—Goodyear Technical Man—prescribed a 6-inch, 4-ply Goodyear Blue Streak Belt for service on that gruelling transmission from the 24-inch pulley of the drive shaft to the 8-inch pulley on the pulverizer.

Today the whole plant of Nast Brothers Lime & Stone Co., at Knowles, Wis., is standardized on Goodyear Belts. The initial installation, made in the Company's plant at Marblehead, Wis., on the basis of an expert analysis of actual conditions, has grown from that one Goodyear-served drive to a 100% Goodyear Belt equipment in the plant at Knowles. The study that effected savings in power and time and belt outlay was extended to an entire plant in a succession of analyses.

Serving different types of drives, the belts in the Nast plant today are of varying lengths and widths, different ply and type, but they are all of the one quality—Goodyear. On the hydrator there's a 5-inch, 4-ply Goodyear Blue Streak for heavy duty. An 8-inch, 5-ply Klingtite is in the hard service of the crusher. A pair of 4-inch, 4-ply Goodyear Glides work on the pulverizer. On the long reaches of the engine room shafting, where it's 23 to 31 feet from center to center, 6- and 7-ply Goodyear Blue Streaks unswervingly deliver full load of power.

Each of them is G. T. M. specified to its job. No one type of belt could do more than pretend to meet so many varying requirements. So the G. T. M. recommended application of the particular belt to the particular need. And Mr. Nast, constantly impressed with the 22 months' consistent, day-in, day-out, ten-hours-a-day performance of the original belt, met every G. T. M. recommendation with confidence.

And in unison the Goodyear Belts contribute to the plant operation the highest values of good belting. Flexible, they hold to the pulleys. Unstitched, they wear uniformly. They neither rip nor stretch. Judging, as Superintendent Koeding does, by the staying qualities of the original Goodyear Blue Streak, they will outlast by a year or more the life of the average belt. And their first cost was but little more.

The same valuable service from both the G. T. M. and Goodyear Belting is at your command. The G. T. M.'s analysis of a single drive or a whole plant is free to you. Our reward will come from it by the same process which resulted in the Nast Brothers standardization on 100% Goodyear Belt equipment.

BELTING · PACKING · HOSE · VALVES

GOODYEAR

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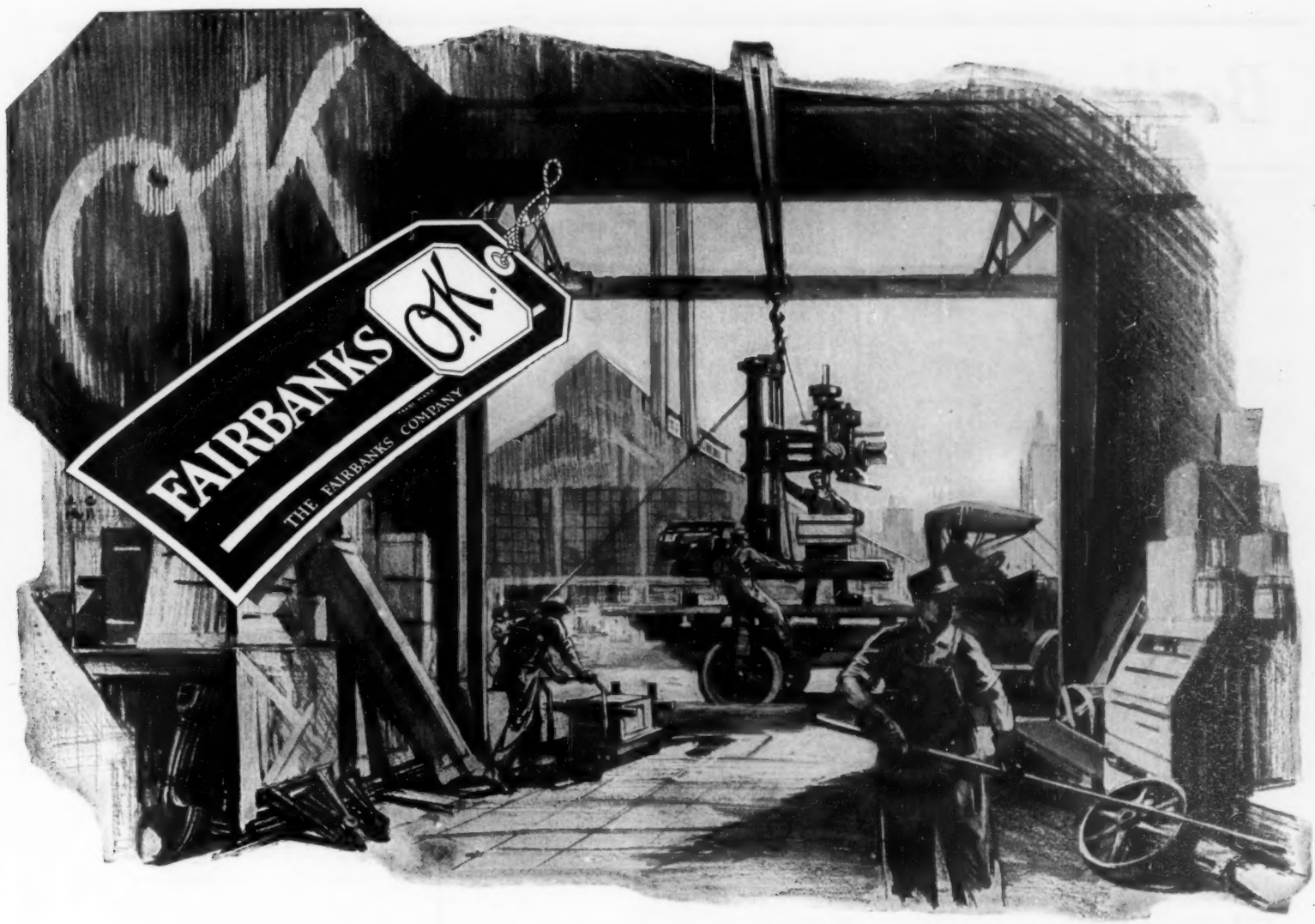

How FAIRBANKS Serves

OUT through the door of the FAIRBANKS Warehouse slides the trolley-crane with its load. A powerful machine is on its way to take its place in America's production chain. Of its performance there is no doubt. It bears the "FAIRBANKS O.K."—a mark of distinction recognized wherever good tools are used.

Mechanical goods of every description—gas engines, pumps, trucks, scales, power transmission, factory supplies—stand in each of the 22 FAIRBANKS Branch Houses ready to serve the nation's industries.

Prompt shipments—usually for your entire order—are a part of FAIRBANKS service.

Your every mechanical want—a dozen shovels or a radial drill, a piece of shafting or a factory complete, can be supplied under "FAIRBANKS O.K." a guarantee that stakes on your satisfaction a national reputation for fair dealing.

For anything you need in mechanical equipment and supplies, call the nearest FAIRBANKS Branch House to serve you.

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FAIRBANKS O.K.

Scales | Automobile and Service Station Equipment | Mine, Mill and Railway Supplies | Power Transmission | Valves | Engines and Pumps | Machine Tools | Trucks and Wheelbarrows

Boiling Water three inches under the ice!

THERE is nothing new in the idea of covering pipes so that some of the heat in them may be saved.

But the exact science of maintaining temperature of fluids in pipes and other containers passing through a medium of different temperature is of comparatively recent origin.

To know the value of heat-saving materials and the correct manner to use them is the basis of the science of insulation. And it is to this knowledge, combined with years of manufacturing skill, laboratory research and the application of our products, that Johns-Manville insulation owes its position today—in fact, it is the mother business of this Company.

For instance — it is doubtful if, twenty-five years ago, the conditions shown here and described in the column to the right could have been met efficiently. Now such a problem is simply a matter of engineering calculation, based on materials whose efficiency is accurately known in advance.

Accurately known because Johns-Manville insulating materials are the result of the most careful study of all materials and methods for heat saving. No Johns-Manville insulating material is advocated for use until it has proven with exactitude to be the most efficient for the purpose.

How it was done

THE two steam lines are each 2193 feet long, running cross-country on overhead supports—all exposed to weather the entire distance.

Despite the fact that the initial gauge pressure is 160 lbs. and the superheat 94°, so little heat escapes that snow and ice lie on the pipe line—unmelted.

The picture above will give you a good idea of how this remarkable heat saving was secured—and by these standard Johns-Manville materials:

Asbesto-Sponge Felted Sectional Insulation, 1½" thick, was first applied to the pipes and wired on without canvas.

Johns-Manville Hair Insulation, 1½" thick, was then wrapped around the Asbesto-Sponge—and finally

3-Ply Johns-Manville Asbestos Weather-Proof Felt was wired on over the Hair Insulation to make an absolutely weather-proof jacket.

You will note that these are all standard Johns-Manville Insulations, included in the list below:

Asbesto-Sponge Felted, 85% Magnesia, Asbestocel, Zero Insulation, Anti-Sweat Insulation, Ammonia Insulation, Underground Steam Conduit and Insulating Cements

H. W. JOHNS-MANVILLE CO.
New York City
10 Factories—Branches in 63 Large Cities
For Canada, Canadian Johns-Manville Co., Ltd., Toronto

JOHNS-MANVILLE SERVICE COVERS THE CONTINENT

Through—

Asbestos
and its allied products

INSULATION
that keeps the heat where it belongs
CEMENTS
that make boiler walls leak-proof
ROOFINGS
that cut down fire risks
PACKINGS
that save power waste
LININGS
that make brakes safe
FIRE PREVENTION PRODUCTS

JOHNS-MANVILLE
Serves in Conservation

SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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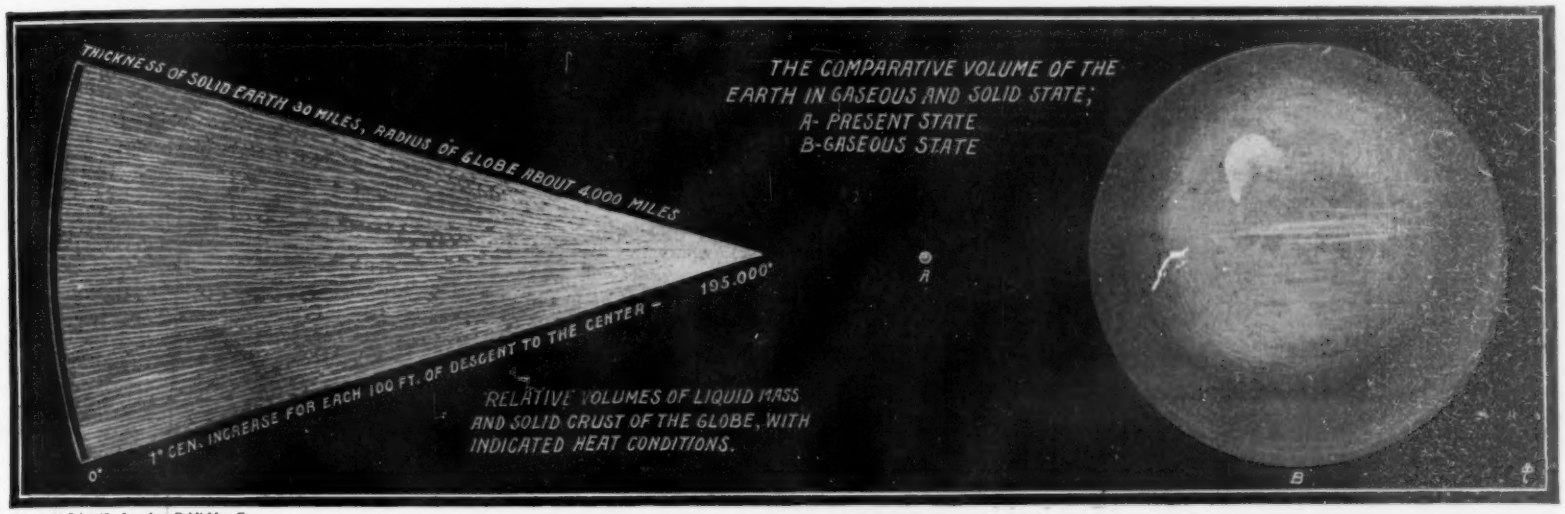
THICKNESS OF SOLID EARTH 30 MILES, RADIUS OF GLOBE ABOUT 4,000 MILES
1° CEN. INCREASE FOR EACH 100 FT. OF DESCENT TO THE CENTER =
195,000°
0°
RELATIVE VOLUMES OF LIQUID MASS AND SOLID CRUST OF THE GLOBE, WITH INDICATED HEAT CONDITIONS.
THE COMPARATIVE VOLUME OF THE EARTH IN GASEOUS AND SOLID STATE;
A- PRESENT STATE
B-GASEOUS STATE
A
B

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At the left is indicated the small proportion of the whole which is constituted by the solid crust of the earth in its present form; at the right, the relative size of the earth as it exists today and as it would be if converted into a mass of gas substantially free from pressure.

The earth as a mass of gas

A Gaseous Earth and the Space It Would Occupy

IT has been estimated that the center of the earth has a temperature of 195,000 degrees Centigrade—a concentration of heat that surpasses anything the imagination can conceive, and one which we are told will reduce to a state of vapor all the substances that enter into the composition of the globe. Furthermore, we are assured by the astronomers that our planet has been at one time an aggregation of wholly gaseous matter. Such statements seem somewhat contradictory until we recall that our early astronomical lessons made the following graphic comparison:

On a globe six inches in diameter, the land to be in proportion should be represented by the thinnest writing paper; the hills by small grains of sand; the elevated ranges by thick drawing paper; the water in the ocean by a brush dipped in color and lightly drawn over the surface of the sphere. With these facts before us we are perhaps less confused, and better able to imagine a thin-skinned earth with its interior in a doubtful state.

But we may again be thrown into mental confusion when we are told that a substance in the gaseous state occupies a space 1,800 times greater than when solid, so that the earth, if reduced to gas, would be as large as the sun. No mere word picture will aid our conception of these statements; it is necessary to give drawn illustrations that will show the comparative sizes of the earth in its present solid and its primitive gaseous states.

With a temperature of 195,000 degrees the incandescent gaseous world would shine in space as a world-made sun, with the same brilliance as a fixed star. Circulating about the sun, it would still obey the laws of universal gravitation, and be governed by the same principles that govern other material substances. But how could the earth, in its present solid state, be reduced to its early gaseous condition?

This question can be answered by first reflecting that the speed of the earth's motion in space is 18 miles per second, and that it rotates about its axis with an equatorial velocity of more than 1,000 miles per hour; and by then comparing the earth, with its colossal speed in its two motions, to a shell from a big gun, which travels at most something like half a mile per second. Both these bodies have the same two motions, forward and rotational. Now when we consider that a hundred-pound shell, coming in contact with an armor plate, will develop by the concussion sufficient heat practically to melt its way through the armor, we can in a way imagine the heat-developing results if a wild-cat celestial object, chasing uncontrolled through space, should collide solidly with our world in such manner as to combat its forward and twisting movements. The force developed in checking the earth's flight in its orbit, under such circumstances, would be proportional, not only to the 18 miles per second at which we travel in this path, but to 18 plus 26 (the ordinary speed of meteors) miles per second, combining the velocities of the two bodies concerned.

It is quite certain that under such circumstances the wanderer and our own earth would be instantly converted to the gaseous condition, in which they would coalesce and become as one, continuing to march through space in a path and at a speed equivalent to the resultant of so much of their original motions as had not been taken up by the impact. Indeed, instead of this being a fanciful or improbable occurrence, we know from centuries of recorded experience that our earth is continually bombarded with meteors, ranging from the insignificant atom of star-dust to the more important aerolitic alien of several hundred pounds' weight, or even a mass measurable in tons. It is even suggested by some scientists that no mean part in the support of the sun's radiance is played by the vast number of meteors which rain down upon the fiery surface of that luminary and develop heat when they are checked in striking.

The recent end-of-the-world scare makes it more or les timely to speculate on whether the globe on which we live will eventually pass to its fate in this way. If so, it is doubly interesting to see what will happen to the earth in meeting its end.—*W. M. Butterfield.*

Rebuilding Europe with the Tank-Derrick

AFTER having established itself as one of the most destructive weapons of the recent war, the tank, in various modified forms, is now building up another reputation as one of the greatest tools in the hands of the reconstructors of devastated Europe.

Credit in generous measure is due the British authorities for their ingenious application of the erstwhile military tank to a large number of distinctly peacetime tasks. Thus the British have modified their small and large tanks for service as tractors for road work, agricultural purposes and canal-boat towing. More recently they have equipped some of their largest tanks with powerful derricks and clam-shell buckets for the purpose of aiding in the work of clearing the ruins of devastated France and Belgium. Mountains of broken brick, stone, lumber, plaster and other debris must be removed before work can begin on new homes and shops and factories that will go to make future villages and towns.

The British tank-derrick is shown at work in our cover illustration. This machine has remarkable facilities for operating on any kind of terrain, no matter how wet or rough it may be. It can bowl over walls and obstacles that stand in its way, just as it did during the days of war. The powerful derrick, operated by the steam engine, together with the large clam-shell bucket, permits debris to be removed and dumped into cars and trucks at a fair rate of speed.

Made of Wood

AN elaborate exhibit of the unique uses of forest products was made at the State Fair at Syracuse and at a score of county fairs as part of the display of the New York State College of Forestry at Syracuse, in its campaign to educate the people of the State to the necessity of preventing waste of the forest areas of New York.

Here are some of the strange uses made of wood and its by-products which will be seen in this exhibit:

"Silk" socks, made from wood fiber, which look like silk, feel like silk, but are far cheaper than the real thing.

Sawdust sausage casings, in which wood, converted by chemical processes into viscose, is used instead of the old type of sausage casings, produced from the by-product of the slaughter house.

Wood-flour phonograph records, compressed under enormous power, to help make music from sawdust.

Tanbark shingles, made from the waste hemlock bark, after it has been through the tannery.

Paper milk bottles to help fight the high cost of living, by saving the breakage of enormous quantities of glass bottles in the kitchen and by the dairyman.

All of these unusual commercial articles are made from what was once waste of the sawmill, and their display is part of the campaign of the New York College of Forestry, to show how close utilization of wood will help to cheapen articles of commerce, and at the same time end the enormous waste that has accompanied lumbering operations.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Endurance of Aircraft

EVERYONE who followed with attention the development of aeronautics in its relation to the great war must have realized that the fighting machine of the air, whether it be airship, airplane, or seaplane, has a very brief life. Certainly under no conceivable conditions of peaceful service is, let us say, an airplane, driven with such a ruthless hand and so constantly strained almost to the breaking point. An airplane engine, which, if properly made, and particularly if hand-made, is, in respect to the accuracy of its workmanship, one of the most expert pieces of mechanism that has ever been turned out by the hand of man, has a useful life in a fighting machine of only a limited number of hours. At the end of a very brief span of service it will show sufficient deterioration to render it unreliable and even dangerous for service over the enemy's lines.

But for commercial service it is not necessary, as in war service, to drive the engine to its fullest capacity, and it is constant driving at the highest possible speed that shortens the life both of plane and engine. The commercial plane not only has the advantage that it is driven well below its maximum capacity, but because it is not so imperative to cut down weights to the lowest possible limit both in planes and engines, the commercial plane can be of more rugged construction. Quite *a propos* of this discussion, and serving to show that even a fighting machine may have a considerable term of life, is the case of a fighting machine from the seat of war, as quoted in *Aeronautics*, which had been in continuous commission, first on the fighting front and then in Holland, for over two years, without expenditure for renewals or repairs. The machine was flown over to Hendon where it was open to public inspection, and subsequently was employed freely in journeying to various parts of the country.

The life of an airship is, of course, very much longer than that of an airplane or seaplane. In the first place, its framing is entirely of metal, which, with proper upkeep, is not subject to deterioration. The canvas covering is, of course, more vulnerable, and in an airship subject to considerable use, its life will be not over twelve months. The breaking up of the fabric is hastened, of course, by the fact that it is merely stretched over the duralumin frame and the action of the wind causes a continual slatting of the canvas, which hastens its breakdown. As to the engines, there is everything in their favor as compared with the airplane engine. The demand for lightness is not so severe, and they can be built therefore of more rugged construction; moreover they are rarely, if ever, run at full power, and, as the airplane has a multiplicity of engines (from four to six in the larger machines) it is possible in a long voyage to give each engine, in turn, a period of rest for cleaning and repairs. Consequently, the life of an airship, should it meet with no disaster and not become obsolete through rapid advancement of the art, should reach to several years.

Trade-Mark Piracy

AMERICAN law demands that the person seeking to establish title to something that has never had an owner do so by taking possession. After he has taken possession the law will ordinarily confirm his ownership, as of a mining claim or a homestead; but any suggestion that he is going to take possession and wishes this step validated in advance is repugnant to our procedure.

In other jurisdictions this is not so. You can buy a mining concession in China, and until you get ready to begin mining others will be excluded from the territory involved. You can buy title to vast portions of the public domain in the Latin republics, without ever having seen or intending ever to see the land acquired. The idea that any step on the part of the owner presumptive is necessary to establish title does not exist in the modern versions of Roman law.

This difference in viewpoint is seen again in the trade-mark laws of the various nations. Such marks are acquired property in the same sense as is a portion of the public domain; and the United States demands that before it secures title in any individual, that individual do his part by actually taking possession of the mark and using it. Until he has done this we take the attitude that it is not his mark, and that therefore he can not protect a claim to it.

But other countries handle trade-mark business just as they do other claims to new property. If you want a mark, you file application for it, and, just as in the case of a slice of the public domain, it is yours barring some prior application. The only criterion of ownership is priority of application.

This, as we have frequently pointed out, is where the trade mark pirate comes in. In Argentina or Brazil or some other potentially valuable market he registers in his own name the established marks under which a variety of standard American products are sold. Nobody knows or cares anything about this until the American maker of one of these articles decides to engage in export business. When he tries this, however, he finds that the marks which he has created and made valuable are not his property in the foreign market, and that he must either buy out the usurper or do business under a new name to which none of his prestige can attach.

Of course the wise manufacturer protects his trade marks all over the world—it costs nothing, in comparison with the security afforded. But to the man who has neglected to do this, perhaps through ignorance of the vicious possibilities of foreign law, it is small consolation to be told that his troubles could have been avoided. He wants to know, first of all, why laws which put such a premium upon sharp practice should stand on the statute books of a friendly government. And to this very direct question what answer is possible?

The granting of trade marks on mere application protects no legitimate interest, and serves no legitimate end. The only person who can possibly profit from such a law is the man who is ready to seize the mark that has been established by another. A very flagrant instance of this sort of thing has just come to light; the New York *Times* tells us how a wily Portuguese has registered in his country and in his own name the marks of a large number of American automobiles, trucks and tractors. He has never made these articles, and apparently has never even dealt in them; but that makes no difference in Portuguese law. All he had to do was make application and pay the fees, and the marks were his in Portugal.

Indeed, by an extraordinary state of affairs, his usurpation of these marks is of even wider effect. Portugal is in the Berne Convention, along with twelve other countries, the chief of which are Austria, Belgium, Brazil, France, Italy and Spain. One of the provisions of this convention is that trade-marks properly registered in one of the member countries shall be thereby protected in all the others on payment of a small fee at Berne. Accordingly this pirate, by the simple registration in Portugal of 43 American automotive names, has become the recognized proprietor of these names in twelve other countries, save where the rightful American owner of one of these names may happen to have registered it previously.

In the course of time, it is given us to hope that the principle of the Berne Convention will be applied universally, to the extent that the originator of a mark, on registering it in his own country, shall by international concord be protected against its registration by any unauthorized person in any foreign country. In the meantime, let us say once more what we have said so often. Register your trade marks in all foreign countries of any importance. It costs only a few dollars, and then you are safe—your marks are yours, to use whenever you may find occasion to do so.

Ships That We Should Build

ALTHOUGH the SCIENTIFIC AMERICAN has urged strongly that it would be folly to go ahead just now with the construction of the six 42,000-ton battleships, we would not have the impression go forth that we are opposed to all naval ship building. On the contrary, there are certain types of vessel of which the Navy stands sorely in need, vessels without which it would still be characterized by that lack of balance which was so glaringly manifest, and to which we so often drew attention, in the years preceding the war.

As matters stand today, we have no scout cruisers that are worthy of the name. The "Chester," "Salem," and "Birmingham," which did good work during the war in convoying, are too small and too slow to meet the exacting requirements of modern scouting service. The scouts of the British Navy have gone up in size to from 5,000 to about 10,000 tons; they carry heavy armaments of 6-inch and 7.5-inch guns, and they have speeds of about 30 knots. High speed is an absolute necessity in ships that must scout far ahead of a fleet, say, of battle-cruisers whose speed may range from 28 to 32 knots and who maintain high speed in any weather that comes their way. For this reason the scout must have length and weight.

Now we had made an excellent start before we entered the war by authorizing ten large and powerful scouts of 35 knots' speed, work upon which is now being prosecuted; but ten of these ships is not sufficient for a navy of our size, and an additional ten should receive the endorsement of Congress. Just what the present design of these scouts is has not been made known. The original design was not altogether satisfactory, there being some question of longitudinal weakness in the hulls; but we presume that has been set right and that we now have a standard design to which we can build in numbers.

Another type of greatly-needed vessel in our Navy is what is called the flotilla leader. This is simply an unusually large destroyer of about 2,000 tons' displacement. It is a development of the war, and on each side in the various engagements these vessels acted as the leaders and flagships of the separate flotillas of destroyers when going into action. Their greater size enables them to carry all the essential facilities aboard for a small flag ship, with accommodations of a flotilla commander. Compared with the destroyer, they have superior signalling and range-finding appliances, their battery is heavier, and they have a radio equipment of much greater range. Furthermore, when battle-cruisers are using their full speed in an engagement, the average destroyer is rather put to it in the effort to match the battle-cruiser's speed, and hence flotilla leaders, with their greater size, are selected to act as battle-cruiser screens on such occasions.

Finally, we should build a number of submarines of a more or less experimental type. The Board recommends, first, a submarine with a very wide radius of action, a heavy armament and the longest practical radio-sending range. Speed both on the surface and below would be sacrificed to other qualities, and the vessel would carry four bow and two stern tubes, fifteen 21-inch torpedoes, two 6-inch guns and an anti-aircraft gun. The length would be 300 feet and the surface displacement, 2,000 tons. It is also proposed to build a long-radius mine layer, similar to the U-117; and thirdly, we should build a "general purpose submarine" of about 900 tons, which should be the best combination that the Department can evolve as the result of past experiences gained with different designs of our own and German U-boats.

Electricity

A New Insulating Material.—A new product suitable for use in electrical insulation is being obtained from the treatment of kelp in Australia. The moist precipitate is subjected to pressure and formed under pressure, after which it is hardened by treatment with formalin. The finished article is made by turning on the lathe, a process which is said to be perfectly satisfactory, and a high polish is applied. The raw material is to be found in large quantities around the coast of Australia and particularly on the Tasmanian shores.

Testing Lamps Without Unpacking Them.—One of the leading distributors of gas-filled tungsten lamps has recently introduced a novel method of packing these lamps, which permits of testing them without the removal of the packing. The lamps are packed in an ingenious, strong carton that contains no excelsior, with its attendant fire risk, and that occupies one-third less space. The carton is provided with a transparent testing disk, through which shines the light from the lamp. The base of the lamp is left protruding through a disk at the end of the carton, so as to facilitate testing. All in all, this packing is certainly ingenious and highly practical.

Our Copper Production.—During the past four years the cost of producing copper has more than doubled, according to *Electrical Review*. Statistics show that the cost per pound in 1915 varied from 6 to 10 cents, while in 1919 this cost varied from 12 to 22 cents. Costs today are calculated on a somewhat different basis than in 1915 in that formerly no charge was made for depletion, and credits were allowed for gold and silver recoveries not now so treated; but these two items do not affect the comparison by more than one cent per pound. War devastated Europe was counted on to absorb enormous tonnages of American copper in reconstruction, but to date foreign purchases have been small and until credits to foreign customers are forthcoming it is stated that it is needless to look for a correction of the present unsatisfactory conditions.

Bare Wire for Low Voltage Circuits.—In the course of a discussion regarding overhead lines, a Canadian electric company recently presented some interesting conclusions regarding the use of insulated wires for low-voltage lines, instead of the proposed bare wires. While the company in questionn has used bare wire for city distribution in the case of 2,200-volt circuits and although it is generally understood that the insulation on the wire, especially after it has been baked out, is no adequate protection for that voltage, insulated wire is useful because the insulation protects the wire from mechanical injury and prevents linemen coming in contact with live lines already installed. In order to show differentiation between primary and secondary lines, lines of 2,000 and 4,000 volts are erected on porcelain insulaters, while low-voltage lines are on glass insulators.

Automatic Telephones in New York.—The telephone company operating in New York City has recently announced that, following exhaustive experiments, it has developed a machine switching central office system that has proved so satisfactory in a number of practical trials as to warrant its use in several places within its territory. Installations are now being made in Dunkirk, Ithaca and Geneva and the work is expected to be completed about the first of the year. In New York City it is planned to place this apparatus in the three new exchanges, but none of these installations can be completed, according to present estimates, much before the end of 1920. The latter changes are expected to help meet the abnormal demand for telephone service in that city. The new system has been carefully worked out and the means of coördinating it with the other types of switchboards have been so perfected that the different types of equipment will interconnect without difficulty. In fact, a subscriber connected with one of the new switchboards will not need to know whether the called party is connected to a machine-switching or a manually-operated switchboard and vice versa.

Science

The Rockefeller Institute for Medical Research has received from Mr. Rockefeller the munificent addition of $10,000,000 to its previous endowment fund, and is thus enabled not only to strengthen its existing activities but to embark upon new lines of research. This establishment, which was founded in 1901, is now the largest endowed institution for medical research in the world. Its scientific staff includes 65 persons, among them being such celebrities as Simon Flexner, Rufus Cole, Theobald Smith, Alexis Carrel, Jacques Loeb and Hideyo Noguchi. In addition there are 310 employes in the technical and general services of the Institute. The local work of the Institute in New York is carried on chiefly in the great laboratories and the hospital on a bluff facing the East River, between East 64th and 67th Streets. A department of animal pathology is maintained on a large farm near Princeton, N. J.

Drifting Meteor Trails.—The observation of persistent meteor trails is commonly supposed to be valuable as a means of determining the movements of the atmosphere at levels above those which can be investigated by observations with kites and balloons. This opinion should, however, be accepted with reserve. The trails left by various Perseids and Leonids, seen at an altitude of from 55 to 60 miles, have shown movements ranging up to 360 miles an hour, and averaging 121 miles an hour. Such rapid movements of the air at high levels (*i. e.*, in the stratosphere) are quite inconsistent with existing theories of atmospheric circulation. A note in *Nature*, by Capt. C. J. P. Cave, revives the suggestion, previously made by others, that persistent meteor trails result from the ionization rather than the heating of the air, and that the movement of the trail may be purely an electrical phenomenon, independent of the drift of the air at the same level.

The Tariff on Scientific Instruments.—A recent report of the Tariff Commission entitled "Information Concerning Scientific Instruments" presents a large body of arguments and opinions gathered from the Bureau of Standards, manufacturers, universities and societies relating to the question of the tariff on scientific supplies. Two questions are involved; viz.: (1) Should Congress repeal the privilege, now granted to institutions of learning, of importing supplies free of duty? (2) Should the present rates be increased and imported articles now on the free list be taxed? In answer to the first question, only one university professor out of eleven quoted favored the repeal of the duty-free clause; conflicting opinions were gathered at the Bureau of Standards; manufacturers mostly favor repeal (as might have been expected); while the council of the American Chemical Society favors repeal "for a reasonable period of years at least." The manufacturers and a majority of the authorities at the Bureau of Standards favor the imposition and increase of tariff rates on scientific supplies in general.

Licking Postage Stamps.—A discussion of "The Postage Stamp as a Possible Source of Infection" by J. Diner and G. Horstman appears in the *Medical Times* for October, 1919. The writers obtained postage stamps from fifty different places, note being made in each case whether the stamps were kept exposed on the desk or held for sale in a drawer or cash register. Laboratory tests showed that no stamp was free from germs. Twenty of them contained colonies too numerous to count. Among the germs were colon bacilli, staphylococci, streptococci, pneumococci and diphtheroid bacilli. Apparently there was little difference in bacterial content between the stamps exposed on the desk and those kept in drawers. The amount of danger presented by these organisms cannot be stated, as, unfortunately, no tests were made to determine the virulence of the germs. In commenting on these results, *American Medicine*, while not encouraging the common practice of moistening stamps with the tongue, points out that if stamps were a grave source of infection a very large percentage of the population would undoubtedly be suffering from infections due to this cause. The fact is that most oral cavities will reveal the presence of some or all of the organisms above mentioned, whether stamps have been licked or not.

Aeronautical

Aircraft Exposition in New York City.—The Second Annual Aeronautical Exposition will be held at the Seventy-First Regiment Armory, New York City, during March 6 to 13, inclusive. The public will have an opportunity to see what American designers have accomplished in developing commercial airplanes—planes for private use, for sporting or touring purposes, or long-distance transportation of freight and mail.

The Vicker's "Viking", reported to be an amphibious machine of the flying-boat type but fitted with a retractable chassis, has been successfully tested on land. Trials on the water appear not to have been made so far. The machine is a single-engined affair of quite small size and is fitted with accommodation for pilot and mechanic and four passengers, or, alternatively to the latter item, 800 lb. of freight. Fuel for five hours, roughly 500 miles, is carried.

Germany's Air-Post Plans.—Negotiations are being carried on between German and foreign firms with the object of securing Germany's participation in an international air-post service. Regular air-mails between Berlin and Copenhagen are expected to begin shortly, and arrangements are being made with the other Scandinavian countries. An important part of the service will be the conveyance of "aerograms" to relieve the telegraphic service. The shortage of gasoline in Germany at present is restricting the use of aircraft for mail purposes.

German Airmen and the Bolsheviki.—No matter what official Germany may say, Germany proper is in touch with the Bolsheviki authorities in Russia. Again the Roumanian troops have captured a large airplane which made a forced landing at Hotin, in Bessarabia, owing to engine trouble. The crew of the machine consisted of two German officers and three mechanics, who had with them 360,000,000 roubles for the Bolsheviki troops in Ukraine, a printing machine to print banknotes, and several thousands of jewels of all kinds. A man who recently visited Germany informs us that he knows of at least two German airmen of his acquaintance who mysteriously disappeared from the aviation field he was visiting, only to be reported as "captured by the Bolsheviki enemy" some weeks later. He remarks that the Bolsheviki must be super-airmen or super-anti-aircraft gunners, judging by the way they bring down these German airmen!

Floating Gears for Naval Machines.—It will be recalled that during the war certain battleships of the Allied Navies were provided with small biplanes which were flown from runways on the turrets. These machines were of the land type, equipped with wheels. Obviously, the pilot had to land in the water when his fuel became exhausted, and the heavy machine was apt to sink in a very short space of time. These facts led Squadron-Commander Busteed of England to consider the question of devising light flotation arrangements which could be attached to the normal land machine and which would enable it to float right side uppermost, and eventually to produce the emergency flotation gear with which his name is now associated. In its original and simplest form this gear consisted of balloon fabric, circular in section when inflated, attached to the lower wing of any ordinary type of biplane between the leading edge and the front spar. These bags were normally deflated and folded flat against the lower wing surface, to which they were held by a fabric flap permanently fastened along the leading edge of the wing and clipped to the front spar by eyelets which could be simultaneously released by pulling a string from the pilot's cockpit. When thus folded, continues *The Aeroplane*, the air bags merely slightly thickened up the front portion of the wing section, and produced no noticeable effect on the machine's performance. When it was desired to alight on water, the pilot first pulled the string releasing the flap, and then by turning on compressed air from a standard compressed air starting bottle into an air injector which communicated with the bags, inflated the latter to their full capacity. The inflated bags provided a large buoyancy ahead of the center of gravity of the machine, and in conjunction with fuselage bag behind the center of gravity kept the machine afloat in its normal attitude.

Multiple Production—A New Slogan

The Necessity for Getting the Most Out of a Given Quantity of Raw Material by Finding Uses for All of It

By R. G. Skerrett

WITH striking unanimity, many of our economic experts have recently declared that our immediate problem is one of stimulated production. In so many words, we are told that our factories and other industries must bend their efforts to a greater volume of output in order that by this increased measure of commodities the supply will be more nearly commensurate with the demand—thus lowering the cost all along the line.

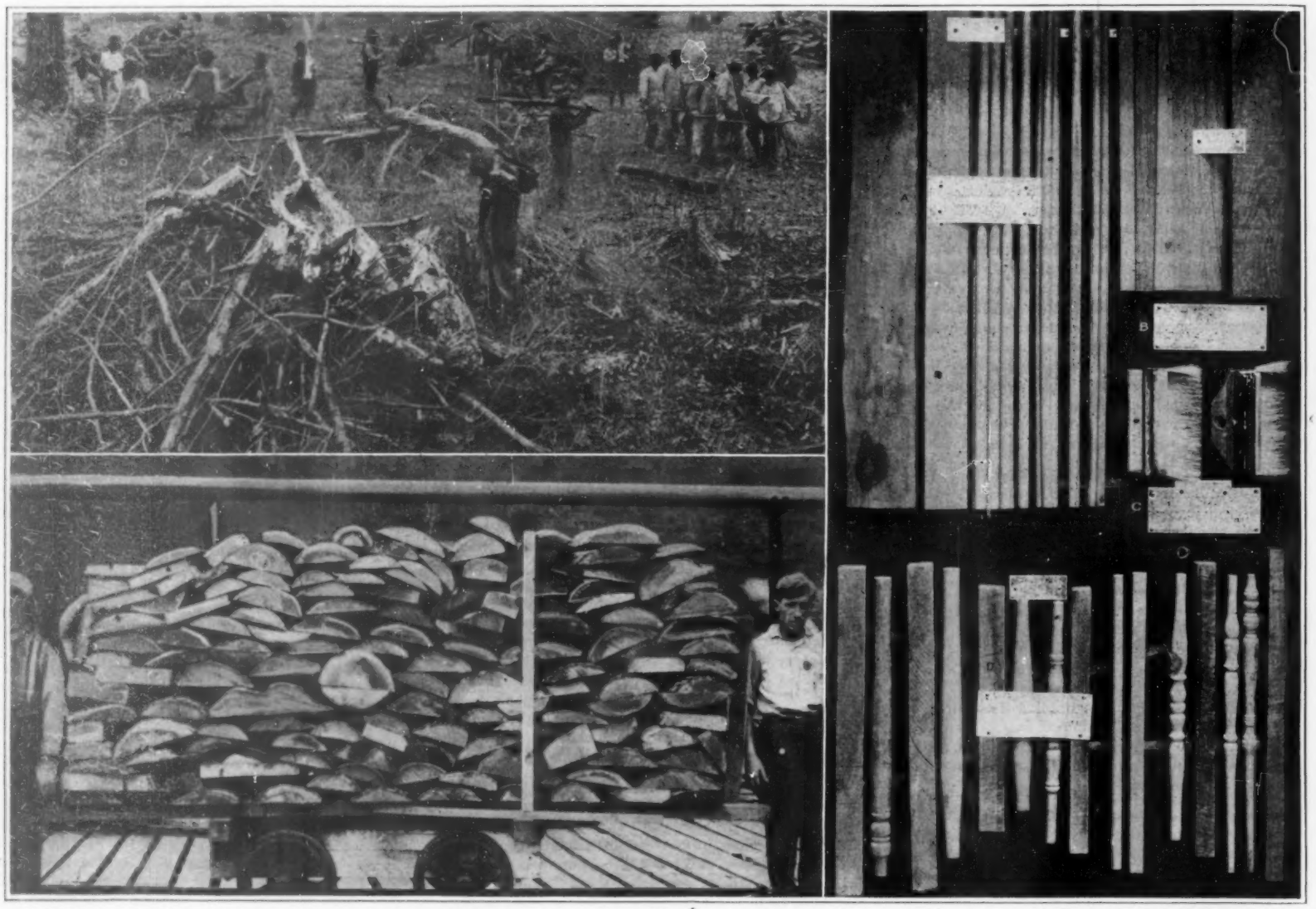
While there is undoubtedly a great deal of sound common sense in this dictum, America will make an egregious mistake if she hearken without reservation to this appeal for increased output, *per se*. In so many words, the disposition would naturally be to turn once more, with greater effort, to quantity production—a form of manufacturing activity which was characteristically native prior to the world war. Indeed, no other country has requisitioned anything like so large a per capita quota of power for its daily requirements and conveniences. But the solution not only of our present situation but of the near future rests on more than mere repetitive operations by which great quantities of identical articles can be turned out rapidly. The world war has profoundly altered our relative position in the matter of recourse to mechanical aids as an offset to low-priced labor.

Abroad, the wellnigh insatiable demands of the late conflict brought home to substantially all of the European participants the inevitable need for the production of vast quantities of munitions while conserving the man power of the nation for other purposes. Wellnigh every commercial competitor with which we shall have to deal henceforth has taken a leaf from our book of industrial life, and we can therefore no longer count upon the lead which we have hitherto enjoyed because of these characteristically American methods and facilities. Our rivals are all bent upon making the most of quantity production in rehabilitating themselves and in bringing their people into positions where they can again enjoy formidable strength in the realm of international trade.

What, then, can we do to neutralize this situation? Have any of our European competitors set us an example which we might in time copy to our material advantage? The answer is, Yes. Germany, especially, has blazed the way for us in the general recognition of the economic virtues of multiple production as distinct from quantity production. That is to say, in her isolation and in her dependence upon her own resources, she has demonstrated how much can be gained by utilizing carefully first the native raw product and then putting to numerous uses successive by-products so that the ultimate manufacturing waste was reduced to an astonishing minimum. In this way, her initial commodities have been made marketable at astonishingly moderate prices, and the by-products, so often looked upon as industrial wastes here, have been skillfully utilized and made to swell handsomely the total returns upon the primary raw substance. We, on the other hand, despite our quantity production, have commonly neglected these subsidiary sources of profit. We have been inspired to this carelessness by the seeming inexhaustible abundance of so many of our basic raw materials; but a day of reckoning faces us, and the drain upon these gifts of nature are in a fair way to be tremendously increased by the demands of the war-wracked nations of Europe. We can supply our own needs and those of other peoples, without grave sacrifice, only if we go in generally for multiple production wherever that economic procedure be possible.

How many of us realize the appalling wastefulness which is practiced in our inroads upon our timberlands? It is authoritatively declared that in turning the forest tree into lumber and then into finished products, the original wood is subjected to greater losses than any other important raw material. Remember, we cut down every year now fully 40,000,000,000 feet of timber, and the wastage is such that only 320 feet of marketable lumber is obtained on an average from each 1,000 feet cut in the forest! Take the long-leaf pine for example. Instead of sacrificing two-thirds of the tree, as is now done, that particular branch of the lumber industry could be made to furnish us daily from the discarded material quite 40,000 tons of paper, 3,000 tons of rosin, 600,000 gallons of ethyl alcohol, and 300,000 gallons of turpentine!

Thanks to the activities of the United States Department of Agriculture, and especially the Forest Products Laboratory, ways have been revealed by which wellnigh every scrap of a tree can be put to good account, and the waste material of one plant or factory can be utilized gainfully in the manufacture of commodities turned out by others. Through the medium



Above: An example of the waste in stumpage and trimmings, which to the value of millions of dollars are burned to get rid of them. *Below:* The sort of slabs which are frequently burned as mill waste, but which can be worked into a wide variety of useful articles. *Right:* Mop handles, brush backs, chair rungs, dowels, shingles, and many other things of the sort here shown can just as well be made from trimmings and mill waste as from boards of standard sizes.

Some ways in which we can get more value from the same quantity of a single raw material—wood

of the Wood Waste Exchange much is being done to promote the further working up of by-product lumber, but the practice is relatively only in its infancy with us. Finally it should be kept in mind that the alcohol that can be made from sawdust is chemically identical with grain alcohol, and therefore valuable for many industrial purposes. As a source of energy, in place of gasoline, it is used successfully and extensively abroad. A ton of so-called wood refuse will yield as much as 20 gallons of alcohol.

In the last two or three years every one of us has had the value of coal brought home to him more or less forcibly or disagreeably. As a people we have gone on digging into the bowels of the earth unmindful that we were continually reducing nature's source of supply, and doing this in a woefully extravagant manner. For anthracite we have been willing to pay a higher price because of its comparative smokelessness, and we have considered bituminous coal somewhat contemptuously—condemning it because of its smokiness and relegating it to what might be called the humbler and dirtier services in the realm of power generation. But this grimy fuel is rich in properties which we have gone on squandering while some of our commercial rivals abroad saw to it that these constituents were reclaimed. In the end, they obtained a smokeless fuel in the form of coke in addition to the several by-products secured during the coking process of the bituminous coal.

Messrs. Chester G. Gilbert and Joseph E. Pogue of

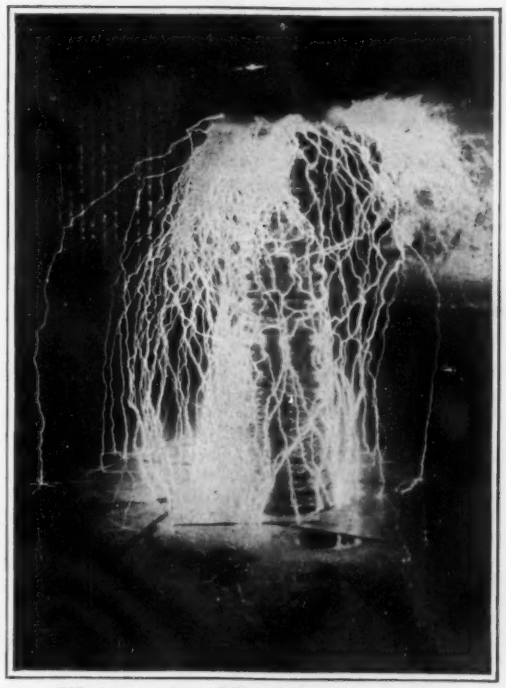
(Continued on page 72)

A Half-Million Volt Test for High-Voltage Insulators

WHAT is believed to be the highest voltage equipment ever built for practical testing purposes has recently been installed at Palo Alto, California, for the purpose of putting transmission line insulators through a third degree, electrically speaking. This equipment permits of tests with voltages up to 500,000 and frequencies up to 60,000 cycles, continuous oscillation.

The condenser proper of this testing equipment is contained in a structure consisting of a wooden frame of studding and rafters lined on the inside with corrugated galvanized iron. Immediately in front of the doors a concrete pavement has been laid, and it is in this space that the tests are made. Under the favorable climatic conditions of this location it is not considered a disadvantage to have to make tests in the open air.

A Poulsen arc converter of 30-kilowatt rating supplies energy for charging the condenser. For convenience in testing, a projection termed the "turtle neck" has been built to extend from the condenser plate to beyond the shed and over the concrete paving, so that experiments and tests may be carried on in the open. The "turtle neck" consists of a telescoping arrangement of sheet-iron pipe in short sections that can be slid in or out to secure the length desired. Tests are ordinarily conducted between the outer end of the "turtle neck" and the ground. Where an insulator is to be subjected to high-tension tests it is hung from a pole near the entrance to the condenser house, and the upper end connected to the "turtle neck" while the lower end is grounded. When the arc generator is started up any voltage up to half a million may be obtained, depending on the atmospheric conditions. The accompanying illustration shows a discharge across a post-type insulator under test. The insulator which is equipped with a corona shield, stands 37 inches high, and is designed for 110,000-volt, 60-cycle works. This flashover is occurring at 234,000 volts and 51,000 cycles per second.



What a quarter-million-volt test means on a 110,000-volt post-type insulator

Searchlights and Motion Pictures

THE remarkable night scenes that have now become quite commonplace in American photoplays are due in large measure to the use of powerful searchlights. In fact, the development of high efficiency searchlights for military purposes led to the introduction of this means of illumination, and it is held by many film men that the day is not far distant when one or more powerful searchlights will replace the vast batteries of arc lamps or mercury-vapor tubes now employed for illuminating the photoplay sets.

The smaller units are rated at 100,000 c.p. and the light is said to be highly actinic, which misleads cameramen who gage their exposures by the apparent volume of light. One unit is sufficient for illuminating a large set, and by means of an iris shutter it is possible to regulate the area of the illumination. Sharp shadows can be avoided by the ingenious use of diffusers and reflector screens, just as is now done when working in sunlight. The main advantage of the searchlight, however, is that the lighting is centralized and therefore more convenient and less costly to operate than the usual scattered lighting units. In filming night scenes the searchlight has the field to itself, since it can flood wide areas with a powerful illumination. The more powerful units permit scenes to be filmed one-half mile away from the source of light.

Apparently this idea of searchlight illumination, first used in the United States, is now being copied by producers in other countries. Proof of this is found in the accompanying illustration, which depicts a German film producer using German army searchlights for nocturnal filming operations.

Technology students finding the mass of the earth

German army searchlight used by a German film producer in making night scenes

Weighing the Earth

A STANDARD experiment which deserves to be carried out more frequently than seems customary is that of weighing the earth. The fact is, the earth weighs something like 6,000,000,000,000,000,000,000 tons; as the scientist would put it, 6×10^{21} tons; or in more ordinary language, six billion-million-million tons. Nor is it such a great trick to find this figure with the apparatus that we are able to bring to bear upon the problem.

In this matter we have a little the better of Archimedes. He found that to move the earth he needed an extra-terrestrial resting place for a fulcrum; and had he been asked to weigh the globe on which he dwelt, he would doubtless have similarly asked for a giant scale-pan large enough to hold that globe, and a fixed point among the stars on which to hang it. But far from this being any necessary feature of the determination of the earth's weight, the experiment is sufficiently simple for it to be performed in the ordinary class-room. In fact, they did it only the other day at Massachusetts Institute of Technology, as some of the daily papers reported at the time. The process took only a few minutes, and when it was over Professor Louis E. Dorr, in charge, said that the errors of observation, and those due to the slight fundamental inaccuracy of the scheme employed, would at the most amount only to a few million pounds in one direction or the other—a mere nothing in proportion to the vast bulk under observation.

The law of gravitation, which still works so far as ordinary observations are concerned, in spite of Dr. Einstein's little furore of recent date, tells us that all bodies attract each other with a force that depends, among other things, upon the relative masses of the bodies involved. So the students attached two small spheres, carefully weighed to the most excruciating accuracy, at the end of a small rod. The spheres were freely suspended so that they could be swayed in any direction. They were hung by threads of quartz drawn out to one-twelfth the thickness of an average human hair, so that there should be a minimum of torsional resistance to any movement that they were impelled to make. These threads, of course, are barely visible to the eye.

Next on the list of properties were two lead balls of about ten pounds each. Lead was used in preference to iron in order that no magnetic properties might interfere with the accuracy of the results observed. Placed in the vicinity of the swinging spheres, these lead balls at once made their presence felt by an infinitesimal deviation of the spheres. The distance through which the spheres moved under the attraction of the lead balls was in fact so small that it would have been hopeless to attempt its direct measurement. So it was magnified! That is to say, a tiny mirror was attached to the quartz thread, close enough to the spheres so that its movement to all intents and purposes duplicated that of the spheres; and these movements were observed as reflected in a large mirror forty feet away.

On the basis of the known weight of the tiny spheres and the lead balls, the movement which the presence of the latter caused in the former made it possible to calculate the force which the lead had exerted upon the spheres. At the same time, it was already known what force the earth, with its gravitational field, was exerting on the lead balls. So the weight of the earth was then found as the fourth member in a proportion of elementary simplicity.

The quartz threads used in this experiment at "Tech." are probably the smallest ever manufactured. They were produced by melting the ends of quartz crystals together and then pulling the crystals apart.

Some Phases of Reconstruction

A Contrast Between the Problems It Presents to Europe and to America

By Hon. William C. Redfield

THE problems with which the United States has to deal differ both in kind and degree from those which trouble Europe. The great industrial districts of Belgium and northern France were not only overrun but ravaged. In some part the industrial buildings were destroyed; in larger part the equipment was stolen; in complete degree the materials and finished products were taken. The manufacturer of those countries, as he goes back to the site where his industry once flourished, finds no materials with which to work, no stocks from whose sale he may recoup his weakened finances, sometimes no machinery with which to work, sometimes no factory to contain his machinery. Let us suppose, however, that he is so fortunate as to have buildings and equipment ready to his hand, or that in the few months that have passed since military operations ended, he has been able, in one or another way, to procure them—how shall he get to work? Materials are not available. Credits are not sufficient. His force has been broken up; many of his workmen slain or maimed; others dispersed. Here is a task of true reconstruction, physical rehabilitation. Patiently he must find means for credit, secure materials, reorganize his force, hunt up former customers, restore old avenues of trade, and he will do well if he is fairly running on his new course by the time a year has elapsed from the armistice. It is likely to be two full years before anything like normal conditions return.

The manufacturer in Great Britain is not in quite so hard a case, for his factory is physically intact. It may, indeed, have been made over for war purposes and require renewal and rearrangement ere it can readily serve the needs of peace. His plant may have been diverted from its original purpose, and he may have been caused to specialize in lines with which, before the war, he was unfamiliar. He may have the task of rearrangement—restoration—rather than that of physical reconstruction. He will find difficulty, too, in obtaining a supply of raw materials, not so serious as his brethren across the Channel, perhaps, but will still find it necessary to pay prices higher than any of which he ever dreamed for the material he needs.

As all these manufacturers, however, look out into the New World they find one change so radical that it alters their entire relations to the commerce, whether domestic or foreign, of which they are a part. This is the extraordinary advance in wages. From German sources comes the statement that labor costs in that country have multiplied by three and fuel costs by six. This is, of course, measured in their depreciated currency; but that very depreciation makes it doubly difficult for them to procure their supplies of raw materials save at onerous prices. From France we are informed that labor costs have multiplied two and seven-tenths times and that material costs are multiplied by three. In Great Britain the wages of seamen are substantially the same as our own, and there is stern resistance on the part of English mechanics and factory operatives generally toward any diminution of wages, which are far higher than have ever been paid since the factory system began. It may seem strange, but it is true, that there is no apparent movement on the part of British manufacturers to insist upon any reduction of the present wage. It appears to have dawned upon the minds of far-seeing men in Great Britain that for a long time past British industy has underpaid and underfed and underhoused its working people, and the truth begins to appear that such a course, however advantageous it may seem to be in an individual factory or on the surface of things, is, when made a general practice, in time destructive of the nation's competing power. England is learning the lesson that others need to learn, that in such respects, as in many others, cheapness and economy are not identical, but may be hostile one to the other. Strong men in British finance now speak, in what seem to us familiar phrases, of adjusting themselves to the advance in wages by better methods, by automatic machinery, by standardization, and by the application of all the principles of quantity production with which industry in the United States is so familiar.

There still are here orators and editors who talk and write in the familiar phrase concerning the pauper labor of Europe. That pauper labor has ceased to be. The conditions which gave rise to the phrase have passed. They may not return. They certainly will not return if the organized labor forces of Europe can prevent it. It is, in my judgment, earnestly to be hoped for the sake of the world and for the good of mankind that they will never revert to what they were. Most significant it is that industrial leaders in Great Britain are in no small part content to have it so. This is reconstruction—but of ideas and of human relations.

Months ago it was said in this country that with us reconstruction was a state of mind, and now that we have passed the first annual milestone of the armistice and are coming near to a peace we see that this is very largely true. We have not the physical problems of France and Belgium. Our buildings and their equipment are intact. Our organizations have rather been enlarged than destroyed. Some of our factories, indeed, find themselves, for reasons arising from the war, with productive capacity greater than is now convenient; but even in these cases men look hopefully to the time in the near future when trade, both domestic and foreign, will absorb their output. We have had to provide for the coming home of our troops, but after all that process has gone on rapidly, quietly, and with but little disturbance, and today the amount of unemployment in the land is not serious and is undoubtedly growing less. On every side one notices the gradual picking up, as we call it, of commerce. Retail trade is good. The stock market is enthusiastic. The men of finance speak cheerfully. All bodes well for the United States. Our rearrangement, our readjustment, is drawing to the close of its first stage. If the progress continues for a few months more, little in our industrial and commercial structure will show that within little more than a year it was substantially all concentrated on the dreadful task of war.

RECONSTRUCTION is a much-abused term. It may mean anything, everything, or nothing. In particular, reconstruction for England, for France, for Germany, for Italy, for Russia, for the United States, is in each instance a thing which must be studied apart, in the light of the very special effects which the war has had upon these countries. In some places reconstruction is in the first case physical; in others it is mainly economic; in still others its chief significance is a moral one. In the address which we abstract on this page, and which was originally given at Cleveland, ex-Secretary Redfield puts forward some very sound and compelling views.—THE EDITOR.

Yet we should be superficial, indeed, if we said no more about reconstruction; if we left it to be understood that the physical security of factories and machinery, our ample supply of raw materials, the abundance of our food, the cheerfulness that is becoming all but universal in our business circles, the abundance of our credits, were all that was involved. There has been other definite reconstruction in America, and it is progressing steadily. It is a reconstruction of ideas and it is based upon sound ideals.

Russia and Bolshevism

Over in Russia we have seen that reaction from absolutism to Bolshevism—each an extreme, each a danger. Each has sought to maintain its power by bloody means. Each, whatever it professes, is the embodiment of cruel force. Whatever Soviet government may be "in posse" the world knows well that it is cruelty and crime "in esse." A New England town meeting in which every citizen took a personal, immediate, and direct part in the affairs of the town was and is an admirable thing, and the choice of three "selectmen" to govern as they still do, our New England villages, has worked admirably as an example of free Government by a free people. But if the New England town meeting degenerates into a mob with the mob psychology and with the spirit of ruin in order to rule, with the conception of tearing down in order to build up, of destroying in order to construct, the New England town meeting becomes a menace. If the three "selectmen" of the New England village abandon the quiet ideals that control them and become a group of arbitrary masters of helpless subjects, if they govern through the obedience of those who obey for the sake of reward, if they impose their arbitrary will upon their people, that excellent system of Government becomes a plague, a thing to be held in check, perhaps to be cut out; until a clear conception of the responsibility of freedom under law shall prevail. So a concept of a Soviet may be wholesome and the reality poisonous. So Russia has reacted from one bad absolutism to another worse one, but now seems to be groping toward the light of moderation, in which progress all wish her well.

One of my associates has said that Bolshevism is anarchy of mind based upon an empty stomach, and in this form it has appeared in Germany and elsewhere. I suspect there is much force in the belief that a square meal and a good suit of clothes are practical remedies for Bolshevism and that employment at good wages completes the conversion.

English labor since the war, while standing firmly for the new position it has gained, has rejected violence, and we may fairly expect that the English genius for compromise and the wide opportunity that the great British Empire offers for enterprise and progress will see her steadily through the present trying days.

Views as to the Justice of Our Social Structure

What, however, do we find in this country? Are we drifting; and, if so, whither? What is the characteristic of the flowing stream of industrial life in America? Organized labor during the war took and held, upon the whole, a finely patriotic position. Has it ceased to be patriotic today? The employers, the leaders of industry of this country, took, upon the whole, during the war, a finely patriotic position. Are they less patriotic today? Have they relaxed their Nation-wide vision, put on the spectacles of near sight, and can they see no farther now than within their office walls, or is their vision confined to the limits of their own factories? We have strikes and we have bombs. Are these the symptoms of revolution? Did the Soviet which had a brief, inglorious career at Seattle represent the serious aspiration and purpose of any considerable portion or element of our labor? What lies behind the complaints as to our social structure which pour from certain of our weekly press? What are the deep, underlying forces in the life of labor? What are the ultimate purposes in the mind of capital? It has been said, and well said, that the nation will prosper most and quickest in which the relations between labor and capital are most equitable and most promptly settled. What progress are we making toward this? We do not lack in the United States the leader of capital who opens his mouth only to put his foot in it, to show that he is still lingering among the fleshpots of Egypt, is wandering in the wilderness, and has made no progress toward the promised land. We do not lack, at the opposite extreme, the man who speaks "plain words," as he calls them, in which he says the social structure here in America is so adverse to the good of the toiler that no course is possible save to destroy it, and that social war and that alone is the remedy; that the alleged capitalistic classes sit in oppression upon the vast mass of mankind and hold them down that they may fatten at their cost; that the door of opportunity is closed to the humble and no one extends a helping hand to lift them up; that there is no such thing as progress out of poverty; and that our evolution, such as it is, is so slow and so cruel that it must needs be altered to revolution ere the average man will have his chance.

It is comforting to remember that once there was an heroic prophet of the Lord who faced the enemies of his faith fearlessly, and then, overcome by a sudden and personal danger, fled far for safety. There he found time to think, or, as we might say, perhaps, to digest his thoughts maturely and consider his country as he saw it and the things that were happening therein. The story goes that there came to him in his retreat a frightful wind that shook the mountains, but the prophet saw that whatever the power of that wind and however great its noise, his God was not in it.

(*Continued on page 72*)

A Competitor for Acetylene

Newly Developed Cutting Gas with Striking Properties

THE successful commercial manufacture of calcium carbide soon made acetylene an active competitor of hydrogen for cutting metals. This condition also brought about a careful study of the merits of an ignition gas for metal cutting. It was known that such a gas served for a moment as fuel to preheat the surface of the job, and that then comparatively a small amount of gas was required to maintain the ignition of the pure iron as the cutting progressed. It was natural therefore to suppose that for the cutting of metals, an expensive gas costing less per cubic foot than acetylene would readily adapt itself to the commercial demand. Hence many special cutting gases have entered the field, of which may be mentioned hydrogen, pintsch gas, blau gas, carbo-hydrogen, gasol, wolf-gas and natural gas.

Valuable experience has been gained from the use of these gases, and much more is now known of the qualifications of a successful cutting gas. A fallacy, probably unconsciously harbored in most instances, is that the efficiency of a cutting gas depends entirely on its thermal content in British thermal units, that is, on the total amount of heat it may make available to propagate the flame in a cutting torch. Of course this is not the case, as may be shown by a simple comparison of blau gas and acetylene. Blau gas has a heat value of 1,800 British thermal units per cubic foot and acetylene, 1,400 British thermal units. This might indicate that blau gas would give a hotter flame than acetylene, which of course is not so, the highest temperature obtainable from blau gas being about 5,000 degrees Fahrenheit, as compared with 6,300 degrees for acetylene. The high temperature of the acetylene flame is partly due to its endothermic property but this does not entirely account for the difference in heating value of the two gasses. It is not only the quantity of heat a cutting gas may contain, but of as much importance is the characteristic of the gas to release its heat units at a rate faster than the absorption by and the conduction of the heat through the metal being cut, as well as the ability of the flame to maintain its initial temperature. Carbon is the chemical element in a gas which probably will produce the most rapid rate of combustion provided it is not retarded by some other element.

From these premises it may be seen that a successful cutting gas should be one which is unsaturated, contains a liberal amount of carbon, combined with the lowest possible proportion of a slow-burning gas, and has a high rate of combustion.

A new cutting gas, named calorene, has been developed for the purpose of meeting these conditions. It is derived from the manufacture of alcohol. It is an unsaturated gas and its analysis shows carbon, 86 per cent; hydrogen, 14 per cent; and a heat value of 1,580 British thermal units per cubic foot. Some relative heat value data may be of interest:

	Carbon per Cent	Hyd'g'n per Cent	Ratio Carbon to Hyd.	B.T.U. per cu. ft.	Maximum Temp. Degrees Fahr.
Acetylene	92	8	11.5 :1	1400	6300
Calorene	86	14	6 :1	1580	6200
Gasol	84	16	5.3 :1	2300	5000
Blau Gas	80	20	4 :1	1800	5000
Carbo-Hydrogen	17	83	5 :1	412	
Hydrogen	—	100	—	322	4000

It will be seen that acetylene has the highest ratio of carbon to hydrogen, with the new gas next in order. This largely accounts for the fine cutting qualities of these two gases, but the unsaturated nature of the gas producing a high rate of combustion also enters, and in this regard of the new gas has so far been shown to be practically the equal of acetylene as a cutting gas. In tests of its cutting qualities on metal of ranging thickness, it was found that while the consumption of oxygen per cubic foot of metal removed increases with the thickness of the metal being cut, both the labor and consumption of the calorene itself decreases. This results in maintaining a low figure for the total cost per square inch of metal cut. A full cylinder of the new gas containing 210 cubic feet weighs 85 pounds, compared with 145 pounds for another well-known cutting gas and 250 pounds for acetylene.

Under certain conditions some cutting gases will leave the surface on each side of the kerf, or slot, of a job covered with an oxide scale so hard that it is impossible to machine the surfaces, and even grinding is inefficient. The metal under the scale is also sometimes liable to granulation and brittleizing due to the action of the flame. The kerf scale of the new gas is about 0.008-inch thick on a 4-inch cut and always is noticeably thin and fragile, and the under surface is undisturbed in hardness as determined by the scleroscope and file. This undoubtedly is due to the rapid and efficient combustion of the gas with oxygen. In steel foundries it is often of first importance to have the surfaces of castings which have been cut left with a scale easily knocked off and with the adjoining metal soft enough to avoid dulling the edges of machine tools.

The explosibility of the new gas will be of interest to many. Its explosive range is from about 4 of calorene with 96 of air, to 14 of calorene with 86 of air; as compared with a range from 3 of acetylene with 97 of air to 70 of acetylene with 30 of air. It may be compressed to 3,500 pounds per square inch and stored as a free gas, no filler being required in the cylinders. This partly accounts for the lightness of a commercial cylinder of the gas. It may be brought in contact with oil and grease without danger of explosion. It will work at low temperature, and its point of combustion is about that of illuminating gas. It has a pleasant odor, and its products of combustion are unnoticeable and harmless.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Crocker-Cooper Helicopter

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of December 13, 1919, there is an article by Mr. Robert G. Skerrett, describing "Helicopter No. 1" and the results that Dr. Peter Cooper Hewitt and the writer have obtained with it. The article speaks for itself. The editorial treatment of the article, however, expreses or implies considerable skepticism so that it has the effect of at least partially repudiating our statements and claims.

For example, the title of the article is, "Again the Helicopter?" The first word is a sort of apology for bringing up such a hackneyed subject. The question mark at the end of the title certainly stamps the article as doubtful. A headline says that we "hope to realize this long-standing dream." An editorial note inserted near the beginning of the article says, "It would be a bold spirit who would claim that the helicopter, that much ridiculed freak, is a practical means of flight."

The fact is that Dr. Hewitt and the writer have already "realized this long-standing dream," so that we no longer have to "hope" to do so. Moreover, we are sufficiently "bold spirits" to deny that the helicopter is either a "dream' or a "freak." We confidently maintain that the helicopter is a very "practicable means of flight."

The editorial note also says, in reference to Dr. Hewitt and the writer, that, "they are inclined to claim success." As already stated, we do claim success, positively and without qualification.

Skepticism regarding what we have done is really complimentary, although it does not at first appear to do so. It indicates that we have accomplished the impossible, which we do not claim. In other words, the solving of the helicopter problem is too good to be true! FRANCIS B. CROCKER.

New York.

How to Decrease False Alarms

To the Editor of the SCIENTIFIC AMERICAN:

Instead of having a fire alarm box around the corner from a police station, place it directly in front of the station house; install an electric bell on the sergeant's desk; run a wire (preferably under ground) from the bell to the door of the box; the instant the handle or key of the box is turned, the bell will ring before the door of the box can be opened.

Apply this method to all parts of the city, in as many places in the city as possible. In many cases it will only be necessary to move the fire alarm box 100 or 200 feet in order to have it within 6 or 7 feet of a building that is open all night, such as a police station, fire house, hospital, hotel, or an "always open" restaurant. In this way the chances of catching false alarm fiends are greatly increased at a comparatively small cost.

This idea, if properly carried out, is a simple and practical way to eventually eliminate the false alarm menace. In connection with this plan it may be necessary, or at least advisable, for a city to offer a reward for the capture of any one sending in a false alarm.

J. R. O'NEILL.

The Origin of High Prices

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of October 4th there is a letter from Mr. J. R. Smith in which he inquires "Who started the high prices"? It is my opinion that the first cause of high prices was as follows:

One of the first effects of the war was to severely curtail the production of goods in Europe; several million producers laid down their tools and went to war. Of course this cutting down of production presently led to a call for goods and materials from this country, and, as we were already deprived of many articles formerly imported, which condition in itself caused a shortage here, we began to feel this scarcity of goods and materials acutely.

This was further augmented by the entry of the United States into the war and the removal of some five million more men from productive labor.

Now what was the effect of this condition on the seller of merchandise? It was as follows:

Assuming that he was not dealing in war supplies but in staple commodities, he presently found himself with an extremely limited supply of goods of any kind whatever. His general business expenses continued almost the same as before, but with sales cut down to probably one-third of normal, it is obvious that the cost of doing business had increased in proportion as the volume had been reduced. Therefore, if he was to continue, he had no alternative but to raise his prices to cover his new and much higher overhead costs.

That, I think, was the point at which the first price advance took place. Of course, later on the situation was further complicated by the demands of labor for higher wages.

There can be no great reduction in prices until production has more nearly approached to our requirements, and even then they will be much higher than the period immediately preceding the war.

New York. C. F. BENEDICT.

What to Do with the Preface

To the Editor of the SCIENTIFIC AMERICAN:

I read with some interest the article under the above caption in your edition of 11th October last. From boyhood I have been an omnivorous reader, and I am now in my seventy-second year. I have always valued a preface so much that it has been my invariable rule to read it twice with great advantage: once before, and once after reading the book itself. The first acts as an appetiser, and the second as a digester.

J. T. THIBOU.

St. John's Antigua, B. W. I.

A Bigger Tree

To the Editor of the SCIENTIFIC AMERICAN:

With reference to your article "Uprooting a Tree with Dynamite," issue of September 6th, I write to say that there is a much larger tree about four miles west of Ore Hill in Chatham County, North Carolina. This is a poplar; it is about sixty feet to the first limb, and at the butt is between thirty-nine and forty feet in circumference. It is hollow for a short distance up, and during the Civil War was used as a hiding place by deserters. When I was a boy, about 1878, fifteen of us could easily pack ourselves into it. But now the entrance has grown up. A few years since, bee hunters climbed a large hickory nearby and reached a large limb and cut it off; this was about sixty feet from the ground. This limb was a good three feet in diameter.

G. W. PASCHAL.

Wake Forest, N. C.

The Alaskan Railways

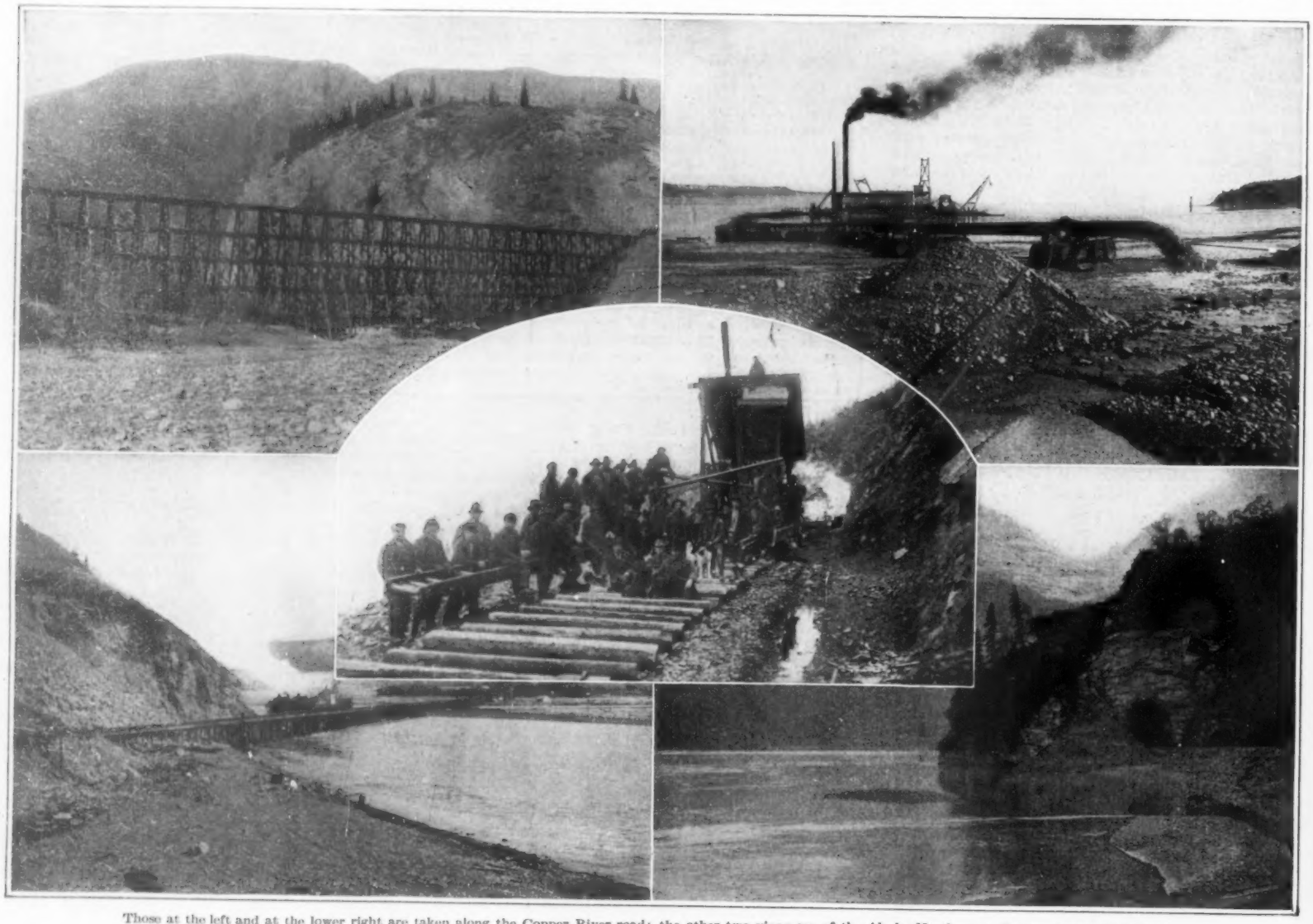
How Construction and Operation Stand Today in Our Northern Territory

By J. F. Springer

THE recent completion by the United States Government of the railway link which connects the Matanuska Coal Fields with tidewater recalls attention to the transportation facilities of the mighty territory of Alaska. About one-seventh of continental United States is in this part of the world, but no other one-seventh is so deficient in railway mileage. In all, there are five railways—the Alaska Northern, the Council City and Solomon River, the Tanana Valley, the White Pass and Yukon, and the Copper River and North Western. The total mileage of all except the first and last amounts to something between 100 and 200 miles. However, the White Pass and Yukon extends beyond the territorial limits and reaches White Horse in the Canadian Yukon region. It is the Alaska Northern Railroad with which the Government is occupied. This line was originally known as the Alaska Central Railroad. When the Government took it over, some 71 miles of road extending northerly from the tidal terminal at Seward had been constructed. The Matanuska coal lies some 118 miles farther on.

Alaska is rich in mineral resources and is thought to have considerable stretches of land of agricultural value. The Matanuska coal was tried on a considerable scale by the Navy some years ago and found to be just about as good as the Pocahontas and New River coals of Virginia and West Virginia. This means, if the big sample tried was a fair average, that Alaska possesses a steam coal equal to the very best to be found elsewhere in the United States—a coal having about 95 per cent of the value of the best steam coal in the world. Now the Matanuska Coal Fields, while some 189 miles from Seward, are nothing like that far from salt water. If one refers to a good map, he will see that Seward lies near the head of Resurrection Bay on the southern coast of the Kenai Peninsula. This peninsula is almost severed from the mainland by arms of Cook Inlet and Prince William Sound. The coal regions is, say, 35 or 40 miles to the northeast of Knik Arm, the more northern extension of Cook Inlet. This is near a station on the railway. The track has, however, covered just about 150 miles from Seward by the time it reaches this point of near approach to the coal, and has only just emancipated itself from the sea coast. It might seem to the casual observer that it was unnecessary to locate the southern terminal so far south as Seward, and that the head of Knik Arm would have been the logical point. In the construction of railways in the Far North, however, and the development of the resources by these roads, considerations of a more or less unusual character have to be taken into account. If a terminal is to be located at the head of some long bay, the question of the continuous navigability of the bay throughout the year may prove decisive.

The present route runs north from Seward to the head of Turnagain Arm, skirts the northern shore of this body of water and the southeastern shore of Knik Arm to Matanuska Station. A branch line connects this point with Chickaloon 37 miles to the northeast, and a spur from this branch runs into another part of the coal fields. Construction of the main line of the Alaska Northern Railroad has already been pushed on to such points as Montana and Talkeetna, which are located 209 and 227 miles, respectively, from Seward. Grading has been carried considerably further. The general direction of the railroad is north and the objective is the town of Fairbanks, 470 miles from the southern terminal. There is even now a short railroad in the Fairbanks region. This is the Tanana Valley line, 46 miles long. It is a narrow-gage road and may for that reason not become an integral part of the standard gage Government railway. Some construction of the latter's main line has been carried out in the Nenana Valley along the Nenana River. Altogether, the Seward-Fairbanks road may be said to have been completed over more than half its length.

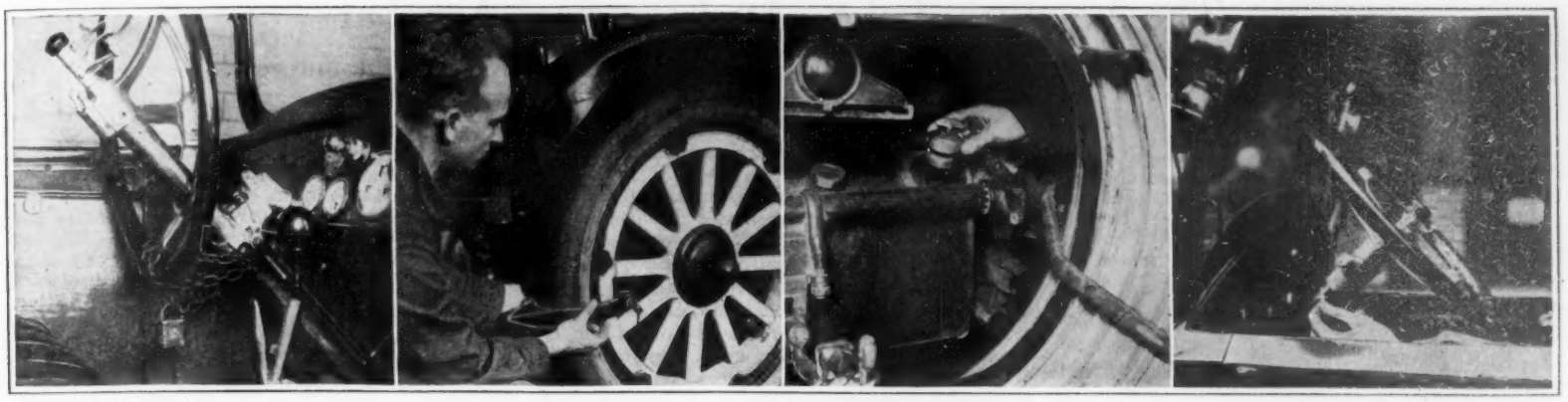


Those at the left and at the lower right are taken along the Copper River road; the other two views are of the Alaska Northern, a Government undertaking

Typical railroad construction in Alaska

Alaska is a tremendous region, and naturally manifests great diversities of soil, topography and climate. The northern region—from the Article Circle up—is of little importance to the world at the present time. The southern region along the coast of the Gulf of Alaska has a climate of no great severity. This is due, doubtless, a good deal to the immediate presence of the great ocean. A considerable range of mountains, extending roughly east and west, divides the southern region from the great Yukon Valley. Seward is in the one region and Fairbanks in the other. The big valley may have important agricultural possibilities in addition to its mineral resources. The Mantanuska River, whose upper reaches penetrate the coal

(Continued on page 76)



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From left to right, these pictures show the steering wheel locked by chain and padlock; a patented lock for the wheel; removing the cap of the gas tank so that there will be no pressure to force the gas to the carburetor; and another device for locking the steering apparatus.

Some tricks that will embarrass the automobile thief

Fighting the Auto Thief

ONE way to foil the automobile thief is to establish the custom of requiring a clean bill of sale with every transaction that involves a used car—a sort of adaptation to the used car business of the title search and title insurance that is accepted as a necessary nuisance in the purchase of a house. But until automobile users can be educated to realize that it is worth while to submit to this nuisance, the man who demands a showing of title will find that the man who is willing to take a chance gets the car, while the cautious citizen gets left; so for the present the remedy for the current practice of automobile thieving must be left to the possessor of a car.

If the steering gear of an automobile is out of commission the front wheels run wild, and one cannot possibly steer the car. Therefore one of the popular methods of combatting the automobile thief is to cripple this part of the car. There are a lot of ways to do this, some of them relying upon home-made or improvised apparatus, others being quite elaborate accessories sold for the single purpose of locking the steering column. In the former class is the chain and padlock which we illustrate. In the latter is another device, consisting of a metal cylinder which runs on the steering rod, and can be locked in either of two positions—down, in such fashion as in no wise to interfere with the free moving of the wheel; and up, completely nullifying the control of the car.

Locking the steering mechanism is not always adequate, however. A thief can sit in the driver's seat, tinkering with the lock and yet look for all the world like a passenger awaiting the return of the owner. Again, a good deal of the current car thievery is done by means of a tow rope; and while it is easier to tow a car in which a confederate sits at the wheel, a wild vehicle can be towed. One way to meet this condition is to lock the wheels, and we illustrate a device which does this. The makers point out that not only does this lock make it out of the question for the wheels to go 'round, but that it is a signal to everybody that the owner has temporarily left his car. No would-be thief could spend many minutes in attempting to file or force this heavy metal without being noticed by police or passing traffic.

Cases are on record, however, where a group of thieves has congregated about

(*Continued on page 78*)

A Three-Story Garage That Needs No Elevators

WE are becoming a highly practical people, even if we must say so ourselves. Until recently garages were built with costly elevators, which had to be used for carrying cars to and from the upper floors. Today we are building our garages on hillsides wherever possible, so as to do away with elevators and the time lost in operating them. The accompanying illustration typifies this modern idea in garage building. Here is a three-story structure, each floor of which can be reached by its individual graded approach. This garage is located on a hillside in a residential section of Washington, D. C.

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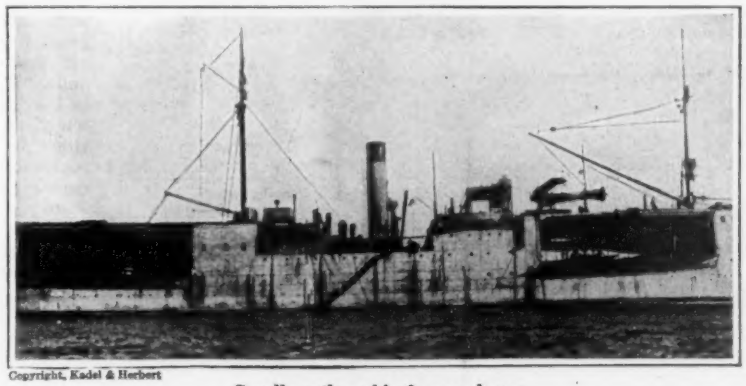
A three-story garage with three driveways that do away with elevators



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Small mother ship for seaplanes

All-metal construction and small proportions make this British single-seater an ideal sport machine

German Seaplane Tender

THE odd-looking vessel shown in this photograph is a German mother ship for seaplanes. We have not many particulars regarding it, but apparently a small freighter was taken over for conversion to seaplane purposes. If so, the topsides have been carried up to double their normal height at bow and stern, and a section of the ship forward and aft has been utilized to form stowage space for the seaplanes. Also, extending from the bridge forward and from the mainmast aft there are two lofty decks, the purpose of which is somewhat obscure, since they are too much obstructed and do not afford sufficient length of run for the landing or taking off of airplanes. The machines shown in this photograph are both of them seaplanes, and the hoisting in and out of the planes would, of course, have to be done by derrick. To facilitate this, it will be noticed that the 'tween-deck garages, if we may call them that, are furnished with projecting platforms, which apparently can be raised and nested against the ship's side in bad weather. Also, a heavy canvas cover will be noticed rolled up against the edge of the top deck above these openings, which can be unrolled and let down to keep out rain and spray.

An All-Metal Biplane for All-Round Use

A HANDY little airplane for individual use which has been introduced in England under the name of the Austin "Whippet" has many interesting features. It is a biplane and its dimensions have been reduced to such a degree as to allow it to be accommodated within the ordinary garage. From stern to stern it measures 16 feet while the tip-to-tip wing span is 21½ feet. But by the introduction of wing-folding facilities the over-all width of the machine is so reduced as to permit storage within a building measuring 18 feet in length by 9 feet wide and 8 feet high. The folding arrangement is simple, it only being necessary to unlock four bolts holding the wings securely and rigidly in position for flight, to permit the wings to be folded back to the side of the fuselage. Folding and spreading the wings is a simple operation and can be carried out in two or three minutes.

The fuselage and landing chassis are constructed of steel throughout, while streamlined steel tubes take the place of the usual bracing wires, so that the necessity to undertake re-rigging from time to time is obviated. In this way the problem of upkeep is materially facilitated. As a matter of fact the question of simplicity has been kept in view throughout, the airplane having been designed essentially for the private aviator. The controls are likewise of the very simplest character, demanding only the minimum of skill, demonstration having

(*Continued on page 78*)

The Vacuum Tube—An Electrical Acrobat

What It Is: What It Does: Who Uses It and How: What It May Do in the Future

By Pierre H. Boucheron

SPEAKING from an electrical point of view, and if the use of such a simile may be pardoned, the vacuum tube is rapidly on its way to become the Aladdin Lamp of the future. In a few short years it has emerged from the experimental stage to a very potential and formidable wonder-machine, capable of performing more practical electrical feats than any other given instrument. For this reason the scientific world in general should know a few facts concerning its origin, how it functions, what uses are being made of it today, and what it is likely to accomplish in the future.

Historical

The vacuum tube in its present form cannot be accredited to any one individual, but is the result of the combined efforts of several radio investigators. It is known and referred to under many names, in several cases the name being closely allied to the purpose for which it is employed, as well as to the researches of individual investigators, such as the Fleming Valve, the Audion (de Forest), the Electron Relay, the Oscillion (de Forest), the Pliotron (General Electric), the V.T. 1 and 2 (Western Electric), the Kenotron, the Dynatron, etc. Of late, however, the name vacuum tube, abbreviated to "V.T." is the more popular term.

In its various forms and applications, the V.T. depends upon the phenomenon of thermionic emission of electrons for its operation; and although Mr. Edison is credited with the discovery of the following effect which bears his name—the Edison Effect—Dr. J. A. Fleming of England was probably the first scientist to make use of the fact that the space immediately surrounding the heated filament of an ordinary electric light bulb is capable of conducting a minute electric current in one direction only, such as a direct current, providing that an insulated medium called the "plate" be inserted in close proximity to the heated filament, and that this plate be supplied with a positive potential. For this reason his invention was named the Fleming Valve. This discovery was immediately made use of in the reception of radio telegraph signals, for in those days considerable difficulty was experienced in providing a suitable rectifier or detector for the received high-frequency oscillations. This so-called two-element valve, however, did not prove very satisfactory as a radio detector.

Dr. Lee DeForest, a pioneer investigator and inventor of radio apparatus, greatly improved the aforementioned arrangement by inserting a third element known as the "grid" directly in the space separating the heated filament and the plate.

This improvement and the signal results obtained by the addition of the grid immediately started many investigators at work to discover the most effective size and spacing of three elements, as well as to secure as near a perfect vacuum as possible; so that today, in addition to being a most effective detector and amplifier of radio signals, the vacuum tube can also be made to generate high-frequency currents now extensively employed in both radio telegraphy and telephony.

The V.T. as a Detector

Probably the most general and important use of the V. T. today is as a detector of radio signals. In this capacity it is quite an improvement over Marconi's magnetic detector as well as the many forms of crystal receivers which, for want of something better, have been in general radio use since the exit of the coherer. Not only is the V. T. an extremely sensitive detector, but by simply changing its circuit connections it can be made to amplify the received signals as well. The great fault with crystal detectors, or rectifiers as they are sometimes called, is their unstable operation; that is to say, it is necessary for an operator to find the most sensitive spot of the crystal by carefully adjusting the point of contact, and this can only be ascertained when signals are being received, or by using an artificial source of oscillations. Even after the proper adjustment has been obtained, the least vibration or movement of the crystal will render the detector inoperative. The same applies to an unusually heavy "stray" or "static" disturbance. The vacuum tube eliminates all this. The operator simply turns a switch controlling the heating of the filament, and the detector is immediately in condition to receive, rectify and amplify at maximum sensitiveness.

AN electric bulb of very much the same general design as those used for illuminating purposes, but including a short length of twisted wire and a small metallic plate, comprises what is generally referred to as a vacuum tube or V.T. It is only within the past few years that the world has come to realize what can be done with such a simple electrical device. And in that short acquaintance there has been born the practical wireless telegraph for long-distance commercial work, the practical radio telephone, and the practical long-distance telephone line. In this article the author endeavors to answer that ever-recurring question: What is a vacuum tube?—THE EDITOR.

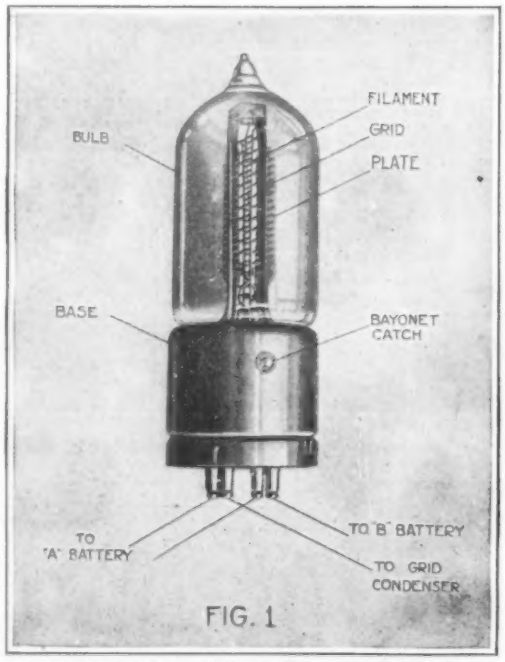
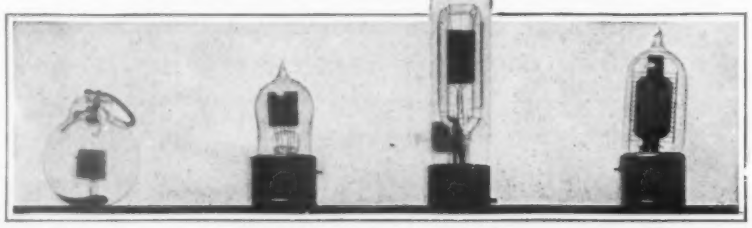


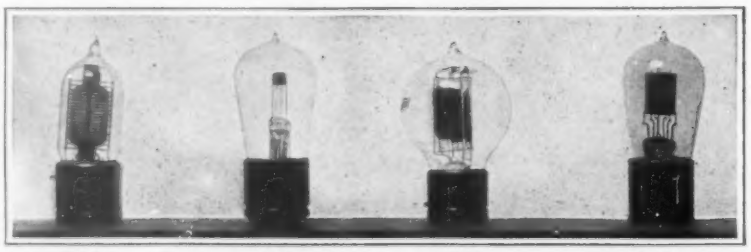
FIG. 1

Vacuum tube with the various parts labelled



DeForest old type — DeForest new type — Navy type tube — W. E. Receiving tube

Various types of vacuum tubes used in commercial and Government work



W. E. Amplifying Tube — G. E. Amplifying Tube — W. E. Transmitting tube — G. E. Transmitting tube

Vacuum tubes for amplifying and transmitting purposes

There are two forms of oscillations used in radio signalling—damped and undamped waves. The older and more generally used damped wave form is employed by ships and shore stations for local work, while the undamped wave form is the one employed in long distance, trans-oceanic radio telegraphy and telephony work. With the V. T. it is possible to receive either form of wave by proper circuit connection, while the crystal and other forms of detectors are capable of rectifying damped waves only. There are, of course, other forms of detectors which may receive undamped waves, but the V. T. is the only instrument which receives both wave forms efficiently.

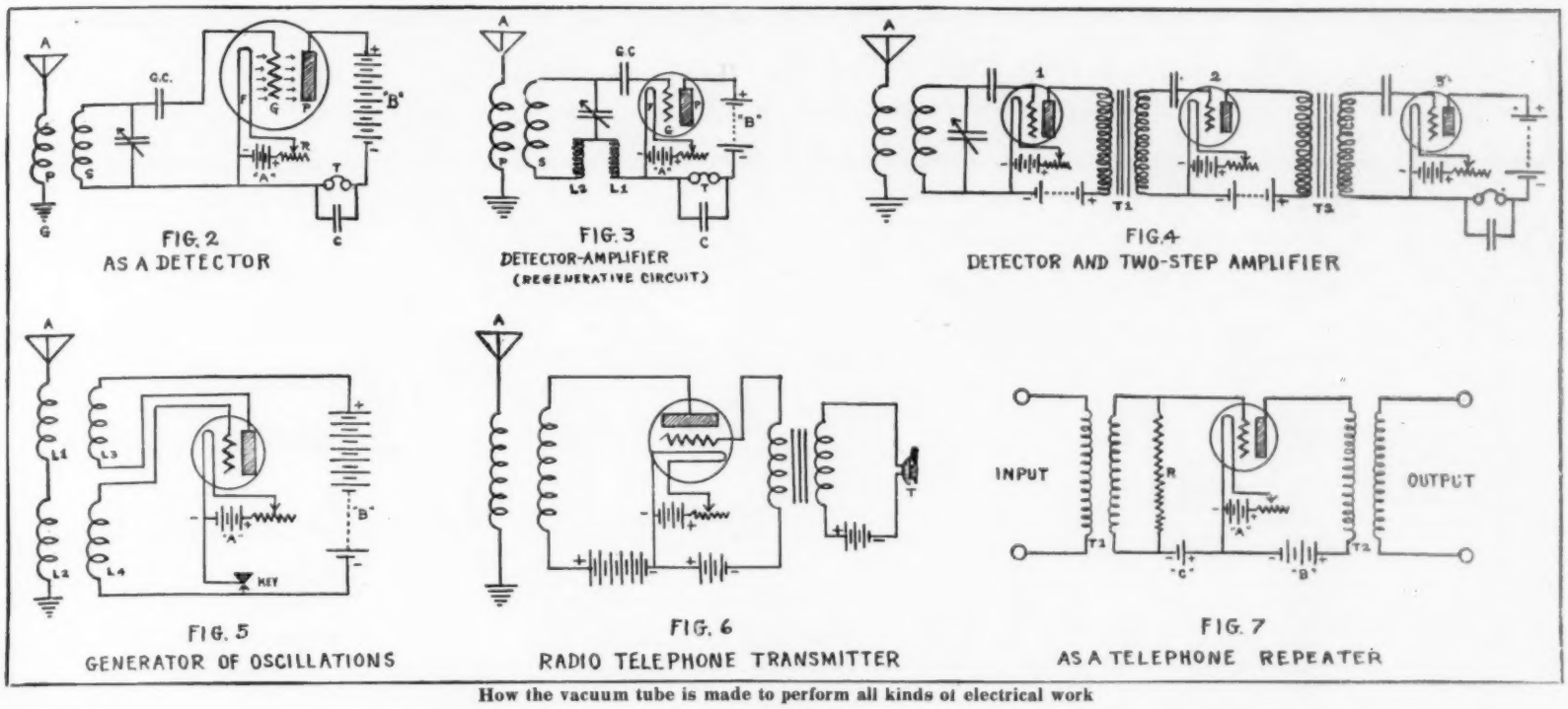
The first of the accompanying illustrations, Fig. 1, shows a typical V. T. of the receiving class, and of a type which has been used extensively by the Army and Navy during the war. As will be noted, it consists of a bulb not unlike an ordinary electric light, provided with a specially-constructed base from which protrude four contacts, two of which are for the filament heating-current supply, one for the plate and the other for the grid connections. The inside of the bulb, which is subjected to a high vacuum, contains a tungsten or oxide filament of long service life; two metal plates and two metal grids, the latter arranged between the plates and filament. The bulb is designed to fit a four-contact receptacle of the bayonet type not shown in this illustration.

Fig. 2, in the group drawing of wiring diagrams, shows one method of connecting the vacuum tube as a detector or rectifier of high frequency oscillations used in radio signalling. The theory of its action as such may be briefly explained as follows:

As soon as the filament *F* is heated to incandescence by the three storage cells comprising what is commonly known as the "A" battery, and the intensity of the current is properly regulated by the rheostat *R*, there are emitted from the filament negatively charged electrons which, in turn, are immediately attracted to the plate *P* due to the fact that this element is connected to the positive pole of a series of small dry cells or storage battery cells known as the "*B*" battery, with a potential ranging from 20 to 60 volts. This process of electronic emission continues as long as the filament *F* remains heated. The grid *G*, which normally lies directly in the path of the electrons, is connected to the aerial *A* or other external source of incoming oscillations through the grid condenser *GC* and the receiving transformer inductances *P* and *S*. These radio frequency oscillations impress themselves on the grid in constantly changing directions; that is, one instant the grid potential is positive and the next instant it is negative. When the grid is negative the stream of electrons flowing to the plate is slightly retarded, causing a slight decrease of plate current; but when the grid is positive there is an immediate additional flow of electrons towards the plate which has the effect of greatly increasing the plate current. In general there is a greater plate current increase when the grid is positive than there is a plate current decrease when the grid is negative. This greater plate current increase therefore is sufficient to actuate the telephone receivers *T*, and the received signals are easily heard by the operator.

Attention is invited to the generally accepted theory that the electron flow is directly opposite to the electric current flow in either a solid conductor or across a vacuous space such as described here. Before the advent of the electron theory it was decided by contemporary scientists that the electric current traveled from positive to negative and although this explanation is arbitrary to the present electron theory, it is still retained at the present day.

In a sense the V. T. by virtue of its action, is a rectifier of high-frequency oscillations. That is to say, it permits but one side (the positive one) of the alternating current to pass through to the plate, and thus the resulting impression



How the vacuum tube is made to perform all kinds of electrical work

on the telephone receiver is a pulsating direct current. This rectifying action occurs because it is only possible for a current to flow through the system when the filament is negative and the plate positive, whereas no current can flow if these polarities are reversed.

Amplification of signals

In the old days of the coherer and crystal detectors, the establishment of long-distance records or the bridging of great distances by means of radio telegraphy or telephony depended primarily on the use of excessive power at the transmitting end, for reception was confined to but one detector; that is, once the signal was received, no matter how weak it was, there was no means of amplifying it, and very often this signal strength was not sufficiently strong to be properly intercepted by the operator. The entry of the V. T. completely reversed this condition, first, by proving itself to be much more sensitive to the detection and rectification of electromagnetic waves than other forms of detectors, and secondly, after having detected the incoming signal, being also capable of amplifying it for reception by the use of one or more stages of amplification. The result of all this is that on the average it is no longer necessary to employ excessive power to bridge the same distances; or, allowing the use of maximum transmitting power, it is now possible to cover approximately twice the distance of former days.

(*Continued on page 78*)

Noise Makers of the Stage

NOISE on the stage is absolutely necessary for many effects, and results are produced by methods that seem very crude to the lay mind. The production of thunder and lightning is, of course, always the most sought-for stage illusion. Thunder is usually produced in two parts of the stage. The crash takes place in one of the fly galleries, while the reverberation or roll is produced by the thunder drum, which is beaten by hand near the back drop. The "cue" is given to the "fly" man by means of an electric light. When he receives the signal, he releases a bolt which allows a pivoted box to dump about 800 pounds of stone and assorted junk down a chute, striking a large iron plate at the bottom. This is immediately followed by 300 pounds of chain; then the roll is begun by dropping five or six cannon balls down a chute which is tortuously inclined and is technically known as a "rabbit hutch." The *finale* of the effect is produced by deforming a large sheet of iron.

Wind effect, thunder and lightning are usually produced simultaneously. The wind machine may be constructed by any carpenter. It consists of a drum with slats that are rotated over an apron of corded silk, which produces the peculiar whistling sound of wind. Usually two wind machines are used—one on each side—in the side scenes or behind the back drop. The wind machine is portable and can be carried to any part of the stage. In small country theaters, there is often no wind machine, and the property master or stage manager, if there is one, is obliged to simulate the effect by whirling a piece of flexible hose around his head. Another method of making noise on the stage is to use a heavy box over which is drawn a calf skin. Upon this the stage hand operates with a padded drum stick. This is often known as the thunder drum, but it is used for additional effects, such as the crash of a battle. It is very realistic when used with the lightning flash.

The "rumble cart" is also used to produce noise.

(*Continued on page 79*)

Copyright, Press Illustrating Service

Left: A typical wind machine. *Above:* Making thunder *Right:* Imitating the sound of waves with bird-shot in a tin whirligig.

Behind the scenes when the action calls for noise

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Shale Oil

ON several occasions the press has called attention to the possibilities of our western deposits of shale. The destructive distillation of oil shale became an industry in Scotland in the early 60's, where it has remained firmly established, although at times saved only by the sale of such by-products as ammonium sulphate. There are no commercial shale operations in this country at the present time although active investigations are in progress and some semi-commercial-scale tests are being made, particularly with reference to the deposits of Colorado, Utah and Nevada. These states have large amounts of easily accessible deposits of shale rich in oil and the geographic and transportation conditions are such as to favor oil production in the states named.

It is generally recognized that we must soon obtain our hydrocarbon oils from other sources than the oil wells of our country, and the shales have assumed economic importance. Oil does not exist in shale as such, but is present in the form of complex organic compounds called "kerogen." This material, upon heating in suitable retorts where air is excluded, yields hydrocarbon oil and permanent gases, while the nitrogenous material of the shale breaks down into ammonia and organic bodies. The operation of shale retorts is fairly well standardized so that what can be done becomes largely a question of economics. The temperatures reach a bright red heat at the base of the retorts and as the shale must remain in the retort for a long while, a large investment in equipment is required to handle a daily tonnage great enough to make the operation pay. The Scottish shales average about 23 gallons of oil per ton, which is lower than the values obtained with western shales, but their yield of ammonium sulphate is much higher and averages between 60 and 70 pounds per ton of shale treated. The maximum amount of ammonia is obtained by heating the shale to incandescence and then introducing steam which dissociates in the presence of a fixed carbon that has been formed in the process of heating. This liberates free hydrogen, which combines with the nitrogen, forming ammonia. In the case of our western shales it may therefore prove advantageous to operate the retorts solely with reference to the oil recovery and fuel economy.

Theoretically the products now obtained from crude petroleum and coal tar may also be recovered from shale oil operations, but it will doubtless be some time before the technology of shale treatment has been brought to the point where it will be profitable to make so wide a variety of products as is now separated from petroleum. After all, the production of oil from shale is a manufacturing proposition requiring large capital and abundant engineering and technical skill rather than the kind of manufacturing operation involving a number of intricate chemical processes and the corresponding highly organized research staff.

Alcohol in Fruit Juices

AT this time when alcohol beverages form the subject of so much conversation, it is interesting to note the following data taken from information supplied by the Bureau of Chemistry in response to an inquiry by Representative Kahn of California.

In the case of fruit juices alcohol results from the fermentation of the sugars naturally present, and a higher alcohol content than the equivalent of such sugars is obtained by adding sugar before fermentation, or in some cases by adding alcohol afterward. The alcoholic content of undiluted fermented juice of cider apples may run as high as 8 per cent, but ciders have been examined which contained as high as 10 per cent of alcohol by volume, and even more. Home-made elderberry wines vary in their alcohol content, depending upon the formula used in making the wine. The natural sugar of elderberries is only 4 to 6 per cent, which is insufficient for wine-making purposes, and therefore sugar is added in varying amounts. By fermenting natural elderberry juice, the resulting liquid would contain about 3 per cent alcohol by volume, but most of the elderberry wines made according to published formulas would carry from 7 to 20 per cent of alcohol.

If blackberry cordial is made by the formula given in the National Formulary of 1916, which is recognized as official, it will contain from 20 to 30 per cent of alcohol by volume, but here again the alcohol per cent will be much lower—probably not in excess of 5 per cent—if the fermentation of natural sugars only is depended upon. Cherry, peach and other fruit bounces, which are ordinarily made by adding alcohol or brandy to alternate layers of crushed fruits and sugar, as generally compounded, are not fermented, and the alcohol content depends therefore on the extent to which the added alcohol becomes diluted by fruit juices. The natural sugar content of the fruit would produce from 4 to 7 per cent alcohol by fermentation, but a fruit bounce ordinarily ranges from 30 to 40 per cent of alcohol by volume.

Wood Preservation

THE Forest Products Laboratory has reported the result of some of its work on the leaching of zinc chloride from wood, particularly railroad ties which have been treated with this compound to prevent decay. It has always been recognized that the rapidity with which the zinc is leached from the wood has an important bearing, but it now seems that in addition there may be a hydrolysis of the salt resulting in the removal of the chlorine radical and the precipitation of the zinc in the form of basic zinc chloride. Strong solutions, 50 per cent or more, of zinc chloride are basic to litmus paper, but on dilution a voluminous precipitate of basic zinc chloride is thrown down and the solutions become acid. The relative proportion of free hydrochloric acid to zinc chloride becomes greater as the dilution increases, and with this in mind experiments were undertaken in search of an explanation of the reason why the analysis of decayed wood which had been treated so often showed a high content of zinc.

In addition to the laboratory tests, sections of treated wood which had been in service but had started to decay were carefully analyzed, and the result was that in every section which showed decay a great deficiency of chlorine was found over that required by the zinc present to form zinc chloride. Indeed much of the wood which had become more or less punky carried sufficient zinc to have kept it in a good state of preservation provided the zinc were present in some soluble form, such as zinc chloride.

The conclusions so far reached are that the presence of comparatively large amounts of zinc in treated materials does not insure that the wood is protected against decay unless a sufficient quantity of acid is also known to be present. The basic chloride of zinc seem to have little or no toxic effect. The problem therefore becomes that of devising methods of treatment with materials not so subject to hydrolysis, which tends to liberate the acid radical.

Suggestions from Canada

THE last report of the Honorary Advisory Council for Scientific and Industrial Research of Canada is just off the press, and describes the continuation of work previously reported as well as the initiation of new activities. The utilization of waste liquors of pulp mills, the possibilities of producing industrial alcohol, the recovery of values from tar sands of Alberta, uses for titaniferous iron ores, the possibility of producing gas for domestic use from waste cereal straws, and the utilization of the low-grade lignite of Western Canada as fuel may be especially mentioned. We have previously drawn attention to the importance of industrial alcohol, and it is therefore noteworthy that this same material is receiving active attention in our neighboring country. Denatured alcohol costs 95 cents a gallon in Canada as compared to 60 to 62 cents a gallon wholesale (Imperial measure) in the United States, and the use of denatured alcohol in motor fuel is recognized as not a remote possibility, so that steps for producing it from the waste materials and other sources are under consideration as well as the possibility of removing some of the handicaps which now somewhat limit its production.

It is estimated that approximately 300,000 tons of fish waste result on the Atlantic and Pacific coasts of Canada yearly, and that at prices which have prevailed for the last few years the oil alone from this material would be worth as much as two million dollars, while protein and other values represent several times that amount. In view of the estimate that it will take twenty years at least to restore the annual supply of the world's foods, especially fats, it would seem that the utiliaztion of such waste must become imperative in the near future.

The Council has conducted research on industrial fatigue, is carrying on forestry studies, and is working toward the establishment of a National Research Institute to be organized somewhat along the lines of the Bureau of Standards at Washington.

Glass-Making Problem

IN *Nature* the Glass Research Association of the United Kingdom makes an announcement in which some of the groups of main problems which it will attack are outlined. These clearly indicate the very large and difficult field which must be covered, and many of these problems are so fundamental that much progress in manufacture cannot be expected until they are at least partially solved. The list follows:

Chemical and physical properties of glasses, fuel, refractories, and furnaces with reference to glass manufacture, treatment of glass-making materials, temperature measurement and control, glass founding and glass-forming operations, annealing, lamp-blown work and other finishing operations, glass-making machinery, and scientific methods of storing, packing and transporting glass articles.

Now consider these factors with reference to the enormous varieties and types of glass articles to which we have been accustomed, from common bottles, food and beverage containers to the elaborate products of lamp-blown glassware, including artificial eyes, X-ray tubes, and other products for scientific purposes, as well as highly specialized types of glasses required for instruments, machinery, building and decorative purposes.

This work will be watched with much interest and in the near future it is hoped that some coöperative research may be undertaken by the glass manufacturers of our own country.

Chemistry and the Boll Weevil

THE relationship between chemistry and the boll weevil is becoming of importance, not only in the effort to exterminate the weevil by poisoning but because the work of the weevil threatens to influence certain of our raw materials. Experiments in Mississippi in the control of the weevil through dusting with calcium arsenate have been quite promising and recent reports indicate that the cost may not be prohibitive. The weevil is poisoned by drinking dew which leaches the arsenic from the salt, and under favorable weather conditions dusting a few times at intervals of one to two weeks very rapidly reduces the percentage of weevil infection.

On the other side, the difficulty of growing profitable cotton crops on weevil-infested land has given rise to the introduction of the soya-bean, and more lately tobacco and other forms of diversified farming. Some of these crops require heavy fertilization and the soya-bean is growing in importance as a source of vegetable oil which lends itself readily to refining by modern chemical methods. Research is needed in connection with using the shorter cotton fibers.

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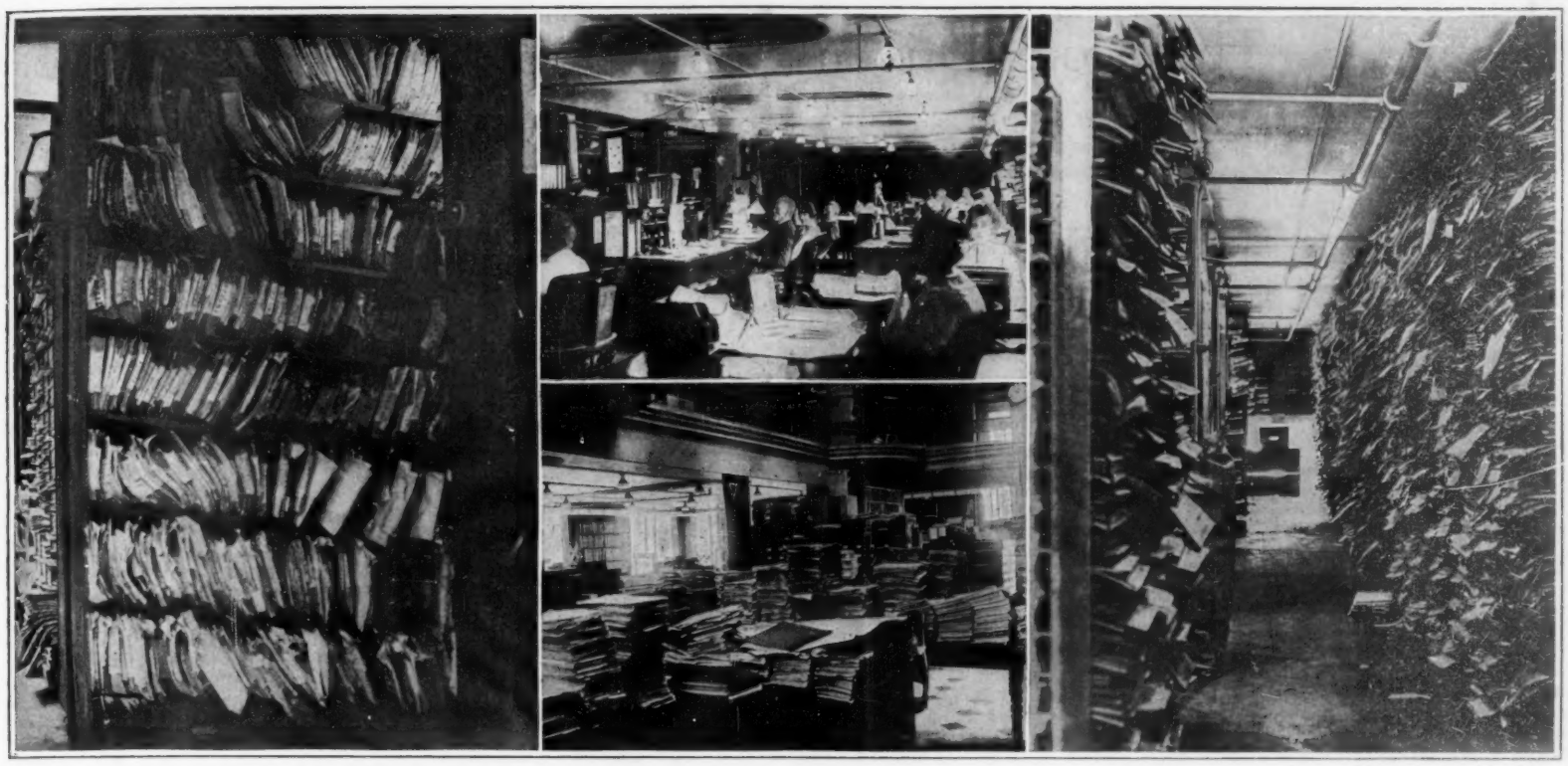


Left: Condition of the shelves where printed copies are kept, due to inadequate force of copy-pullers. When copies cannot be found in this jumble, they are reported out of print. *Above:* Crowded state of the Assignment Division. *Below:* References to foreign patents in the library, awaiting help, not now in sight, to be filed and indexed. Until this is done they are of course unavailable for the very simple reason that they cannot be found. *Right:* Another view indicating why it is difficult to buy printed copies of old patents.

A few Patent Office exhibits

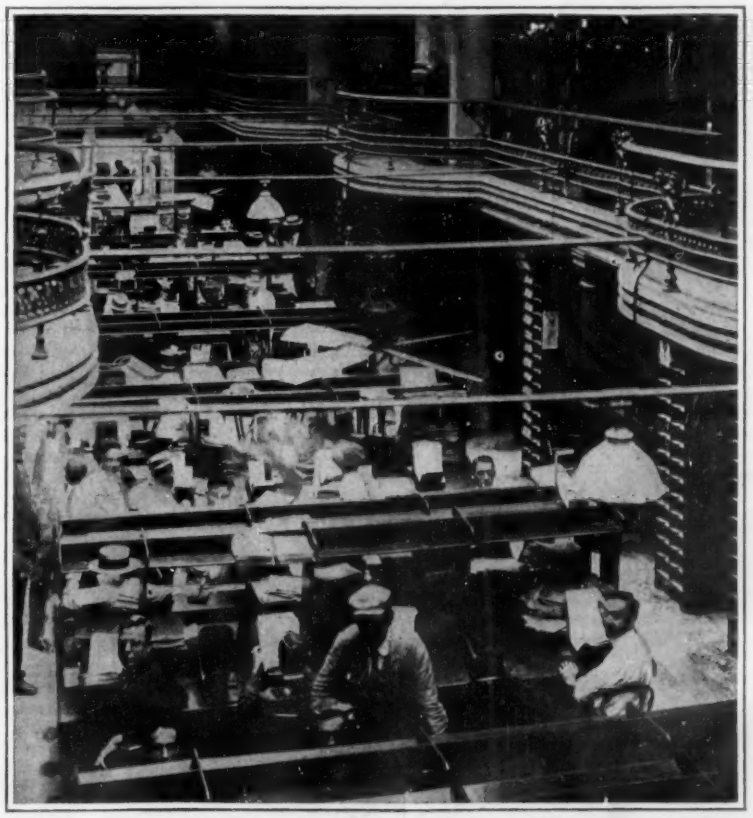
Patent Office Facts

Some Instances of the Condition to which Lack of Funds Has Reduced This Bureau

IN a recent issue we outlined in some measure the present critical conditions in the Patent Office, brought about by the insufficiency of the wage paid, and the consequent impossibility of maintaining a full force of competent men. In order to see for ourselves just what the state of affairs is today, a member of our staff paid a visit to the office to make a personal investigation. Here are a few items that will give a fair idea of the crying needs of this vital branch of the Government.

When an application for a patent comes to the office, it first enters Division A. Here it is scrutinized to determine to which examiner it should be sent, and the papers are looked over to assure that they are in proper form. At the same time the drawings go to Division C to determine whether they are in such shape as to comply with the regulations of the Patent Office. Then they are returned to the application room and attached to the application, which is forthwith sent on its way to the proper examiner.

When the writer visited the Application Room he found that it was many days in arrears. There was no adequate provision for filing the applications which could not be attended to immediately. The reason for this accumulation of applications was very simple. On account of increased demands in other divisions, the force had been reduced to the least possible limit. This threw an enormous burden of work on a few experienced clerks. The chief of this division informed the writer that he had three "adaptables," that is, clerks who were experienced in the entire work of the division and who could tide over a vacancy in an emergency; this however, in addition to doing their own regular work. A few days before our visit one of these all-around clerks had broken down from over-work and his doctor had advised him that he would have to take a complete rest of a month and preferably two months. The day before our visit the second one of these emergency clerks had to give up on account of a nervous break-down, and on the very day that we visited the department the third one was unable to report for work for the same reason, so that the division lost three of the very best members within a week's time, and the chief of the division was at his wits' end to tide over his office work until they could come back.



The Search Room, where much important work in determining the patentability of an invention must be done

Division E is the manuscript and lithograph department. It is here that certified copies of patents are supplied. A force of typists is employed to make copies of patents and applications for court inspection and for the filing of foreign applications. The force of typists in Division E write, on an average, a little more than five thousand words per day. It has been impossible to keep a full force of typists because the Patent Office cannot begin to pay the salaries that are obtainable in private employment. As a consequence, in order to meet the demand, attorneys send their own typists to the Patent Office where they are assigned a space in a very poorly lighted gallery to make their own copies of patents. These are then proof-read by members of the division and certified by the Patent Office. Despite the fact that outside attorneys are helping the government to do the work which it is supposed to do itself, the division is far behind. At the time of our visit there were three million words waiting to be typewritten, and even with the help of private typists less than 120,000 words per day were being turned out. In this department there was last year a turnover of 71 out of 85 members.

Division D, where assignments of patents are recorded, is one of the most important branches of the Patent Office from the business point of view. On the records made in this division hang hundreds of millions of dollars' worth of business. The work here is something like that in a realty title insurance office. Letters and deeds are received for record; the names of parties to deeds, assignors and assignees are indexed; verification of data in the deeds must be looked up on the Patent Office records; briefs must be prepared and recorded by book typewriting machines in books kept by the division. Titles must be searched

(Continued on page 80)

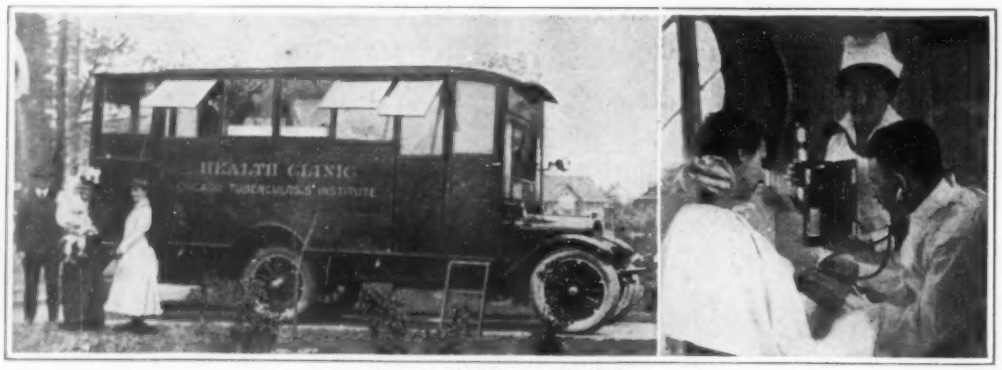
The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

A Hospital on Wheels

THE motor truck chassis has been equipped with many different forms of body but none of the forms devised offers more possibilities for the good of the community than the special hospital body shown in the accompanying illustration. This is one of the many units now engaged in the warfare being waged against the white plague by the authorities in various sections of the country. The body shown is equipped with all the apparatus needed to make necessary tests of a patient's condition and also provides accommodation and satisfactory working quarters for an experienced physician as well as a nurse. The interior of the body is exceptionally well lighted and painted white to augment the effect of the natural illumination provided by the many windows. It is virtually a hospital on wheels. This health clinic travels over the country to the small towns with a doctor and nurse to visit the patients who cannot afford to visit the hospital. When it arrives in a town the local doctor is consulted, he explains his cases, and they coöperate with him. A record is made and his patients examined, after which the hospital on wheels returns to each town every two weeks.



A peace-time motor hospital

Aluminum Wheels for Motor Trucks

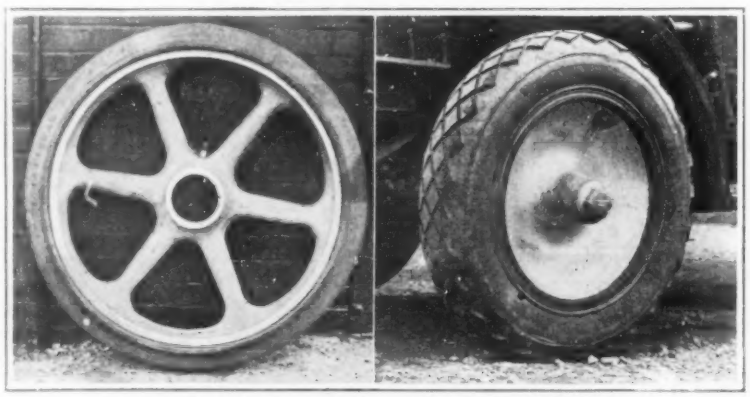
ONE of the interesting recent motor truck developments is the wheel now being worked out experimentally by a large aluminum castings company. The wheel is a one-piece aluminum alloy casting made in either hollow spoke or disk type designs. Extensive road and laboratory tests to date indicate that the new wheel, unconventional in design as well as in material, possesses all the desirable features claimed for the wood or steel wheel, and in addition enjoys certain very important advantages common to neither of the existing types. The aluminum alloy wheel weighs about half as much as any other wheel on the market. It will, therefore, decrease the weight below the springs (the unsprung weight) very materially and at the same time should guarantee ample strength.

The importance of reducing the weight of the unsprung portion of the chassis on motor vehicles is generally appreciated. There is, however, a wide divergence of opinion among the leading automotive engineers as to the proper ratio between the sprung and the unsprung weight. Some hold this ratio to be 10 to 1 while others place it higher or lower as their opinions may be, but it is generally admitted that a great deal is to be gained by saving unsprung weight in the following respects: Economy in tire wear, increased carrying capacity, improved riding qualities, economy in fuel consumption, better acceleration.

It is obvious that when a motor vehicle is traveling at fair speed over an irregular road, there is a tendency for one or both wheels to break contact with the ground immediately after passing over some obstacle. If one rear wheel leaves the road it is free to rotate at any speed which the engine may induce, *i. e.*, at any abnormal rate of speed. Consequently, when the wheel again comes in contact with the road a certain amount of slip must occur until its speed is made to conform with that of the other wheel. This slip is very detrimental to the tire, causing severe road friction and tire abrasion. The rebound or tendency to leave the ground is materially less with light wheels.

The large reduction of the unsprung weight effected by using lighter wheels may be taken advantage of by increased capacity of the truck itself. Take any of the ratios of unsprung to sprung weight advanced by the engineers and substitute for this proportion the reduced unsprung weight figures which the aluminum wheels give. It is found quite possible to increase the load capacity very materially provided the springs, axles, bearings and their coördinate parts are so designed as to allow a factor of safety consistent with the increased load. Or, with the same carrying capacity as originally intended, practically all parts can be reduced in size and section, including tire sizes.

All the arguments advanced by the advocates of lighter cars in respect to economy of operation apply with equal force to the car equipped with aluminum alloy wheels. There is no doubt that a lighter wheel forecasts important saving in fuel, as well as better acceleration. The riding qualities of the truck are also improved by reduction of the unsprung weight. The riding qualities of a truck are as much to be considered as that of passenger cars. Omitting the truck driver's opinion in this connection, it is quite apparent that the less the upward impulse of the unsprung weight against sprung weight, the less the vibration and jar and the less the stress on the springs. Any reduction in the vibration obviously tends to save all parts of the truck and to keep it out of the repair shop. A truck owner dreads to have his trucks laid up for repairs just as the production man shuns idle machines.



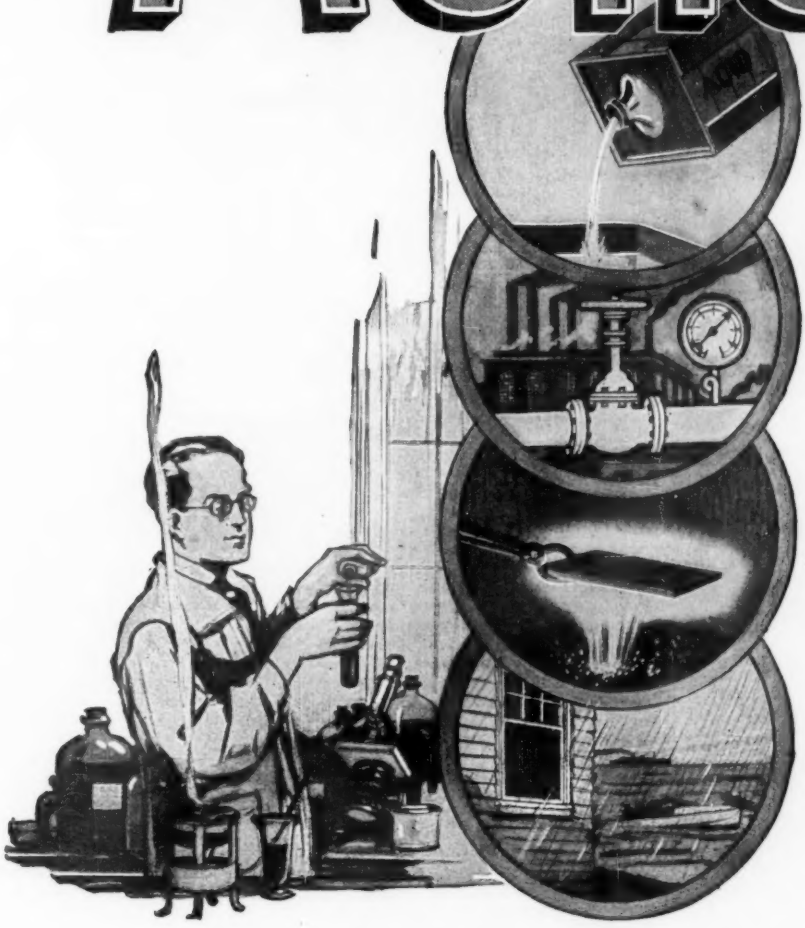
A one-piece wheel of aluminum in spoked or disk design

A Combination Body That Is Truly Useful

AS a rule, when a designer attempts to combine the functions of several devices in a combination form, the mechanism will have a reduced efficiency when employed in any one of the various forms the combination may be resolved into. This is not true of a recently devised motor truck body, which is shown in the group of photographs herewith. The body is a very effective construction when used as either a platform type, as a dumping body or when provided with rack sides for general transfer purposes. A body of the type shown should have many advantages for agriculturists as well as for motor truckmen in general. The choice of a proper body will very often double or triple the value of a motor truck chassis. This is especially true in the general trucking business, varied loads of miscellaneous materials being the rule. A concern at Akron, Ohio, is now using a 3½-ton truck with a special body that gives a very wide range of uses to which the truck may be put. Primarily the body is a platform with metal flooring which can be dumped as it is controlled by a hydraulic hoist. By the addition of side boards, which are also metal lined, they secure an excellent dump body for hauling sand and like material. High rack sides can then be added, giving a body suitable for lighter loads of bulky material.

Three aspects of a recent combination truck body which loses none of its efficiency as the price of flexibility

INCo MONEL metal



withstands

- acids
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—and not only does MONEL defeat the attacks of injurious acids, but it successfully stands up against the many other destructive forces which quickly break down the resistance of ordinary metals.

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MONEL Metal is a natural alloy of nickel and copper. It is as strong as steel, non-corrodible as bronze, more durable than either. It takes and retains a perfect nickel finish. Wherever MONEL is used wear is largely reduced and corrosion prevented.

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Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

COLLAR.—S. ALBERT, Nashville, Tenn. This invention has reference more particularly to soft fold collars wherein it is desirable to have the ends of the folded over top of the collar held closely to the band of the collar. The main object is to provide simple means for holding the collar in shape so as to be form fitting, and in no way interfere with the easy tying of a knot in the necktie.

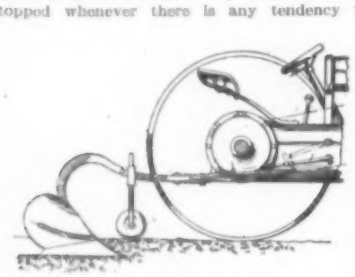
Electrical Devices

ELECTRIC LIGHT CORD AND SHADE ADJUSTER.—C. H. OTIS, 62 Hawthorne St., Hartford, Conn. The invention particularly relates to means for adjusting electric light shades at any angle in respect to the vertical for the purpose of reflecting the light diffusion from the shade or electric light at any desired angle, and further, the adjuster embodies a certain take-up means for shortening or lengthening the cord to which the device is applied, the attachment hooks may be readily applied to any form of lamp cord and shade or lighting fixture.

ALTERNATING CURRENT MOTOR.—H. W. JEANNIN, 2248 Lawrence Ave., Toledo, Ohio. This invention relates to alternating current motors of the type disclosed in patent No. 1,209,443 granted to the same inventor, December 19, 1916. The invention has for its general objects to improve the construction and operation of dynamo electric machines of the character referred to so as to be reliable and efficient in use, comparatively inexpensive, and so designed as to have a larger output without increasing the size of the armature

Of Interest to Farmers

AUTOMATIC STOPPING MEANS FOR TRACTORS.—F. T. RITTER, Edgerley, La. An object of the invention is to provide a device by means of which a tractor may be automatically stopped whenever there is any tendency for



A SIDE VIEW OF TRACTOR AND PLOW, EQUIPPED WITH STOPPING DEVICE

tractor to rear. A further object is to provide a device which may be easily attached to any tractor and which will operate instantly to stop the tractor when the latter has reached a predetermined angle with respect to the ground over which it is traveling, thereby preventing the overturning of the tractor.

POTATO PLANTER.—F. E. MENDENHALL, Kilgore, Neb. This invention has for its object to provide mechanism for taking the cuts from a hopper and delivering them one by one into a dropper chute. In operation as the machine moves forwardly the dropping wheel will be rotated and impaling forks will pass in succession through the extension hopper, and each fork will take up a single cut.

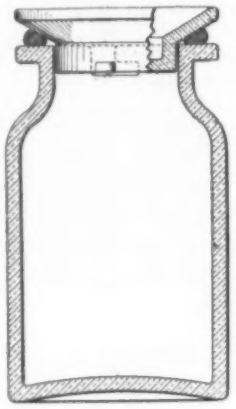
POTATO GRADER.—A. C. MORSE, Box 111, Almond, Wis. The invention has for its object to provide a mechanical device for grading potatoes. The invention comprises a suitable frame upon which is mounted a riddle for swinging movement, the riddle consisting of side members which are connected by a series of screens, the screens are arranged in parallel spaced relation one above another each delivering the graded potatoes at its lower end.

Of General Interest

GUN MOUNT.—W. F. MANUELS, West 8th St., Coney Island, Brooklyn, N. Y. This invention has for its object to provide a gun mount for machine guns for shooting galleries, arranged to limit the pointing movement of the gun to prevent damage to the side walls, ceiling or floor of the establishment or injury to bystanders. Another object is to counterbalance the gun to enable the user to readily move it about for aiming purposes.

FOUNTAIN PEN CLIP.—E. A. TISCHLER, 51 King St., Floral Park, N. Y. The prime object of the invention is to construct a pen-retaining clip in such a manner that it performs the double function of retaining the pen within the pocket of the wearer and also of maintaining the cap upon the end of the pen.

JAR AND CLOSURE FOR SAME.—P. ELLIS, Dec'd, address Fanny Ellis, 158 Calliope Rd., Stanley Bay, Devenport, Auckland, New Zealand. This invention relates to preserving jars, and has particular reference to the closure of same. The jar is constructed with an out-



A SECTION THROUGH A JAR EMBODYING THE INVENTION

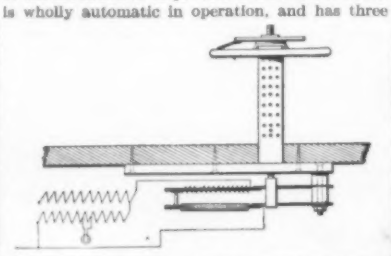
wardly directed flange presenting a plat level surface at the mouth, the cover is provided with projections on the cylindrical portion for locking the cover to the jar. The cover is sealed by a packing which is engaged in the V groove formed by the flange and the cone portion of the cover.

MOVING PICTURES IN COLORS.—J. W. BERWICK, 108 Archer Ave., Mt. Vernon, N. Y. The invention relates more particularly to the art of taking and projecting motion pictures in colors. A more specific object is to provide a method so that it is possible to add, reinforce-accentuate or subdue any of the sharp cut primary colors employed in the taking or projecting of sections of the color separated image that merge in the eye of the observer as a composite or natural picture by the persistence of vision.

WINDOW SHADE ROLLER.—J. SHEPPARD, Winston-Salem, N. C. An object of the invention is to provide a shade roller that can be raised or lowered and held in the desired position by a frictionally operating mechanism. Another object is to provide a bracket, which co-acts with the frictionally operating mechanism in such manner as to prevent the shade roller spindle from riding out of the bracket.

WINDOW SHADE ROLLER.—J. SHEPPARD, Winston-Salem, N. C. Among the objects of this invention is to provide a particular type of bracket and a shade roller with friction locking mechanism capable of limited sliding movement with respect to the bracket, whereby the function of frictionally locking the roller to various adjustments on pulling the shade, and releasing all frictional effort on the roller in again raising the shade are accomplished.

AUTOMATIC THERMOSTAT.—T. J. M. DALY and L. DALTON, care Little Rock Compress Co., Little Rock, Ark. Among the objects of the invention is to provide a thermostat which is wholly automatic in operation, and has three



A SIDE ELEVATION OF A DEVICE EMBODYING THE INVENTION

thermostatic elements, which are actuated by the change in temperature of a resistance coil, the change in temperature in the chamber to be heated, and the change in temperature of the atmosphere in the room or the like within which the chamber is located.

SAFETY DETONATING FUSE.—J. W. TAYLOR, 1128 Foulkrod St., Philadelphia, Pa. The object of the present invention is to provide mechanism in connection with the safety chamber of a detonating fuse for absorbing the explosive energy of the detonator to avoid the transmission of the explosion to the booster chamber. With this device a large safety chamber is not necessary, thus giving more space for the bursting charge of the shell and fuse.

WINDOW SHADE ROLLER.—J. SHEPPARD, Winston-Salem, N. C. The foremost object of this invention is to provide a shade roller that has friction locking mechanism for holding the shade at any position within the range of its movement, the friction locking mechanism being concealed and so arranged that no pressure is brought to bear on the shade bracket.

SECTIONAL POST.—H. E. NEWMAN, Shoshone, Idaho. The invention has for its object to provide a two section post, as for instance, a telephone, telegraph or fence post, wherein that part which is within the ground and more liable to decay may be made of indestructible material or of wood resistant to decay, while the part outside the ground may be of other wood less resistant.

Hardware and Tools

SCREW CLAMP OR GRIPPING DEVICE.—A. G. STRATHERN, care Wm. E. Volz, 6 Church St., New York, N. Y. The invention relates to gripping devices—sometimes called grabs—of the type comprising two arms hinged together like tongs or pincers, a gripping member being provided on the end of each arm, and a rod, oppositely threaded at its two ends, being arranged to engage with the two arms so that by rotating this rod in the one direction, the two gripping members will be forced toward each other and thus grip the object.

UNDERREAMER.—J. W. PIPPIN, Oklahoma, Okla. This invention has for its object to provide a device wherein the cutting bits are so mounted that they may be held in contracted position during the insertion of the reamer by latch mechanism, which is released when the bits are passed through the casing to permit them to expand, wherein they will be firmly braced and held during the cutting action, and wherein means is provided for shielding the bits to prevent the entrance of sand, gravel and the like.

PROTECTIVE COVERING OR CASING FOR PIPES.—M. A. NEAMES, Gramercy, La. The object of the invention is to protect pipes, conduits, mains and other pipes installations from deteriorating action of high heat, moisture, gases and acids, by means of a two section protective covering or casing with clamping and supporting features, the whole being extremely simple in construction and quickly adjustable in place over the pipe wherever installed.

SEALING OR STOPPING LEAKS IN PIPE-JOINTS.—A. J. ROBERTSON, Port Clemens, Canada. The invention particularly relates to means for stopping leaks in pipe joints, and ist particularly useful for joints where there is excessive vibration or poor provision for expansion The device comprises a split metal collar adapted to fit the pipe section. The sections of this collar are joined together by means of flanges and by means of bolts, so that the collar can be easily slipped over the pipe.

Heating and Lighting

GAS ATTACHMENT FOR OIL STOVES.—E. V. JUNGK, 442 Autum Ave., Brooklyn, N. Y. This invention relates particularly to heating apparatus for attachment to oil stoves, and has for an object to provide a construction whereby gas may be applied to any oil stove now on the market. Another object is to provide a gas burner which is formed to surround the ordinary burner of an oil stove and thereby be used at any time without injury to the stove or the oil burner.

SUPERHEATER.—F. C. STIMMEL, care Casey-Hedges Co., Chattanooga, Tenn. The object of the invention is to provide a superheater for steam boilers, arranged to insure the formation of highly superheated steam. Another object is to provide a superheater which can be readily applied to new boilers as well as to boilers as now constructed. Another object is to eliminate the brick curtain wall in the rear portion of the boilers now used to prevent short circuiting of the products of combustion in their passage through the boiler.

Machines and Mechanical Devices

BALANCED VALVE.—J. R. SAYWARD, Lancaster, N. H. The invention relates to valves for controlling the flow of fluids, and has for an object to provide a valve of the type known as balance valves: the invention is particularly designed for use in flushing tanks to control the flow of water into the tank and in which the valve is controlled automatically by a float within the tank.

LAST LINE INDICATOR FOR TYPEWRITERS.—D. G. WHITE, care Hotel Brewster, Boston, Mass. This invention relates to an attachment for typewriters of any kind and which indicate or signal when the end of the sheet has been reached and has for an object the provision of a construction which may be readily adjusted for any length of sheet and for giving the signal or indication at substantially any point between the top and bottom of the sheet. A still further object is the provision of an attachment which is manually set and which automatically assumes an inoperative position

PUMP.—G. E. DENMAN, 3558 Custer St., Fruitvale, Cal. The invention relates to pumps of the air lift type. Among the objects of the invention is to provide an air left pump in which the air supplied is controlled automatically by a trip mechanism actuated by an intermittent water flow, also automatically operated by the same trip mechanism.

FRUIT GRADING MACHINE.—C. FREDRICKSON, 29 W. Marshall St., Rice Lake, Wis. The invention relates particularly to machines for grading potatoes and other vegetable tubers which may be desirable to separate into different grades. An object is to provide a machine which may be used on the farm or plantation for separating the potatoes or fruit into grades of various sizes. A feature of the invention resides in means adapted to spread the fruit out and pass same before operators who will pick out the undesirable fruit before it passes into the grader.

DENTAL ARTICULATOR.—W. J. WILSON, Petersburg, Ind. The invention particularly relates to dental apparatus used for grinding and finishing artificial tooth sets. An object of the invention is to provide the design of a dental apparatus for finishing artificial tooth sets by grinding the connecting faces until they accurately register one with the other, as effectively as that of a well shaped set of natural teeth.

MOTOR DRIVEN DENTAL ARTICULATOR.—W. J. WILSON, Petersburg, Ind. An object of this invention is to provide the design of a motor driven dental articulator which may be assembled in connection with any preferred form of teeth articulators, receive suitable motive power from any source such as an electric motor and continuously operate the articulator until the teeth are adequately ground in shape to the desired engaged masticating relation one with the other.

MOLD LOADING DEVICE.—R. E. MCCAULEY, 417 E. Weber St., Stockton, Cal. This invention relates to a loading device for moulding glass and the like, and has for an object to provide a structure which will quickly load molds to the proper extent without wasting any of the glass. A still further object is to provide a device which is in effect an extension of the glass holding furnace whereby an even continuous supply in a molten condition is provided at all times.

Prime Movers and Their Accessories

VALVE LIFTER.—J. W. HARSLEY and M. P. APGAR, 245 W. 68th St., New York, N. Y. A particular object of the invention is to provide a valve lifter which may be quickly applied to the stem of a tappet valve and to the motor base for lifting the valve tappet spring out of engagement with the valve parts in order that the valve may be disassembled for removal from the internal combustion engine.

Pertaining to Recreation

HYDROCYCLE.—G. BIDONDE, 8626 131st St., Richmond Hill, L. I., N. Y. An object of this invention is to provide a device which will float, which will sustain the weight of the rider and which can be propelled through the water. A further object is to provide a device which can be taken apart, packed in a relatively small space so that it can be easily transported from place to place and assembled at the water's edge by any one of average intelligence, without the aid of skilled labor.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

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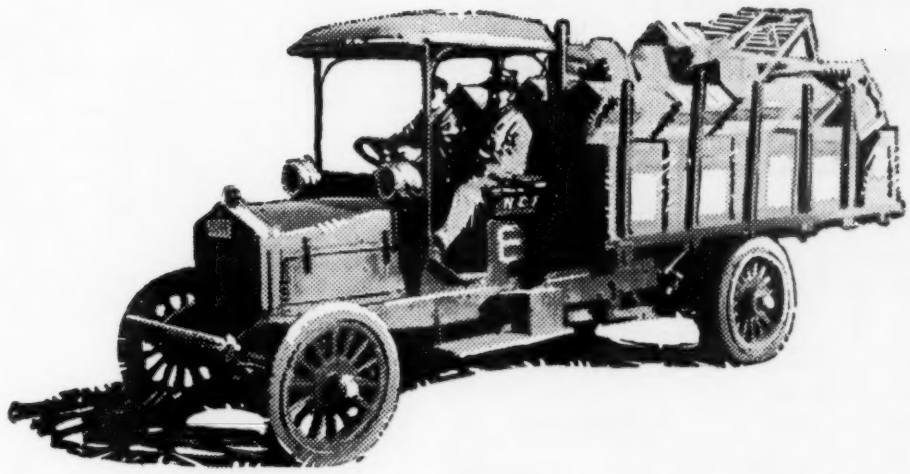


48 of the First Fifty

Pierce-Arrow trucks are still running after 8 years. This absolute reliability takes all of the speculative element out of truck buying.

An idle truck means an idle driver, repair bills, no deliveries. The money you "save" buying a cheap truck you quickly pay out for an idle truck.

Nos. 4 & 5 are used by the National Cash Register Company in Dayton for short haul work. Neither has run over 50,000 miles. Both are still "young", and deliver as satisfactorily as ever. Their service has been distinguished by their ever-readiness. Eight years is by no means the measure of their capacity.

Pierce Arrow

Delivers more work in a given time.

Loses less time on the job and off the job.

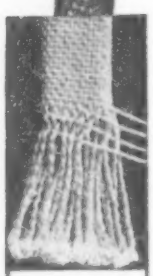
Costs less to operate and less to maintain.

Lasts longer, depreciates less and commands a higher resale price at all times.

THE PIERCE-ARROW MOTOR CAR COMPANY, BUFFALO, N. Y.

What a *woven* covering means to portable electric cord

Here is the ordinary braided cable covering. Note the open and porous construction, easily cut, stretched or unraveled. Compare it with Duracord.



This is Duracord. Thick, heavy strands, *woven* like a piece of fire hose, not braided. Picture shows outside covering only with impregnating compound removed.

PORTABLE electric cord is only as good as the covering that protects it. What kind do you choose—a thin strand, braided covering—or Duracord?

Duracord is different. It has a covering of thick, heavy strands *woven* like fire hose. It can be battered and pounded and abused and stands up as no other cord will.

DURACORD
TRADE-MARK

In laboratory tests it resisted the pounding of heavy hammers, twenty times longer than ordinary braided cord. It stood fifteen times the abrasion of ordinary cord. In actual use it has proved itself so many times superior to other cords as to be a positive economy.

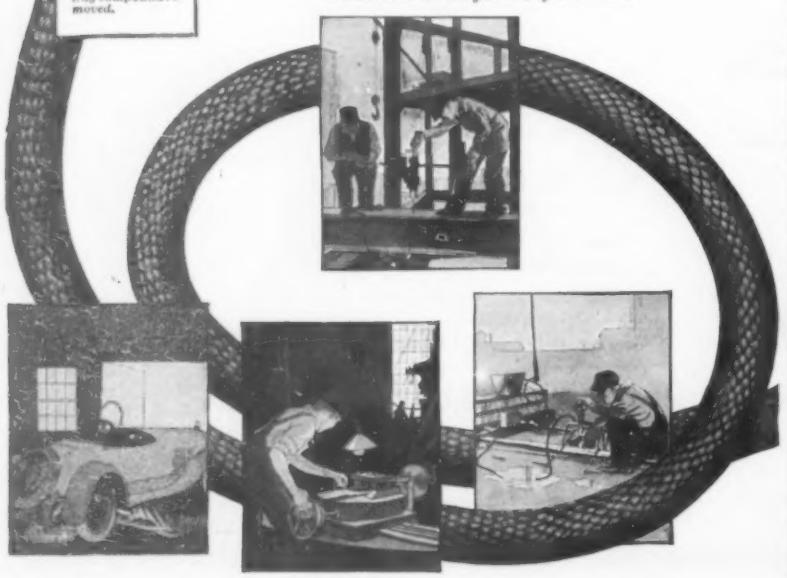
Shipbuilders, manufacturing plants of all kinds, theatres, mines, railroads, etc., are specifying Duracord wherever a portable electric cord is required to withstand hard service.

Duracord will save you money—it will make money for you if you use it in your product. But don't buy it until you see for yourself why it is so good.

Send for samples of Duracord and ordinary cord—test them, compare them in every way. Ask your electrical jobber about Duracord or write us.

TUBULAR WOVEN FABRIC COMPANY
Pawtucket, R. I.

Makers of Duraduct the flexible non-metallic conduit, and tubular woven fabrics of all kinds.



Multiple Production—A New Slogan

(Continued from page 59)

the Division of Mineral Technology of the United States National Museum have made an impressive disclosure of our accustomed wastefulness in burning raw bituminous coal. The figures they have given are based upon the 1915 price of coal at the mine—$1.13 a ton, which was the charge prior to the greater cost induced by war conditions. Similarly, the value of the by-products represents the prices prevailing four years ago, and, relatively, this data applies with reasonable accuracy now. These experts show that a ton of bituminous coal contains 1,500 pounds of coke (a better fuel for many purposes than the coal itself), 10,000 cubic feet of gas, 22 pounds of ammonium sulfate, 2½ gallons of benzol and 9 gallons of tar—the total value of this outfit being, at the 1915 process, no less than $15.59. If we subtract $1.13 from $15.59, the remainder, $14.46, is the material wealth which we pretty generally cast to the winds by way of the smokestack with every ton of bituminous coal that we burn *as such* in steam plants, furnace, etc. True, we are coking bituminous coal to a greater extent than heretofore in retort ovens which permit of the recovery of the by-products in question; but this practice is by no means upon the magnificent scale that it should be.

Taking up the next basic raw material, of which we use enormous and steadily increasing quantities, petroleum furnishes us with another example of American wastefulness—a direction in which multiple production can be resorted to with potential savings running high into hundreds of millions of dollars annually. Petroleum, like bituminous coal, is rich in derivatives which are susceptible of recovery by suitable processes, and, therefore, these values are squandered when the crude oil is burned in the furnace of a steam plant. The measure of this sacrifice becomes plain if the reader be reminded that more than half of the crude oil produced in this country yearly is used as liquid fuel for steam raising. This amount includes both the crude petroleum employed directly for fuel purposes as well as the fuel oil turned out by the petroleum refineries of the nation.

There is a steadily growing demand for fuel oil because of the greater ease with which it can be handled and the better results realized when burned under a boiler compared with the use of coal for the same service. From crude oil as a basic raw material, it is possible to obtain, by refining, gasoline, kerosene, fuel oil, lubricating oils, benzine, vaseline, paraffin, asphalt, petroleum coke, dyes, and hundreds of other useful materials. At the present time something like five per cent of the crude oil handled by the refineries is counted as waste. This, in view of the fact that we are consuming close on to 500,000,000 barrels of petroleum yearly, gives some idea of the loss entailed even in this seemingly modest percentage. But if we remember that a very large part of the petroleum drawn from our wells is used without yielding any of its valuable derivatives through the agency of the refinery, we get a more illuminating grasp of our present spendthrift habits in this department of our raw materials.

It is a matter of record that in our withdrawal of petroleum from its underground reservoirs we have permitted to go to waste natural gas representing the fuel equivalent of millions of tons of coal; and we are informed that quite half of the natural gas developed up to date has been made no use of whatever, despite the fact of its very superior qualities. Apart from these losses through failure to control the escape of the gas, its exhalation leads to a reduction of pressure upon the subterranean oil, and this dissipation of energy makes not only the recovery of petroleum more difficult but actually reduces the quantity which can be brought to the surface.

There is no intention to do more in this article than to call to the popular mind some of the outstanding directions in which we abuse, by inadequate utilization, the raw materials which nature has lavishly placed at our disposal and of which there are definite limits to the supplies in reserve. In hundreds of directions we violate in our industrial life the principle of multiple production, and we do this through wilfullnes or indifference and not because skill and knowledge are lacking here to guide us along more profitable paths.

If one will but inquire, even superficially, into what Americans have made possible through industrial research in the last ten years or so it will be clear how many amazing things have been achieved which, if widely applied, would lead to economies or to material benefits amounting to possibly billions of dollars annually. By-products can undoubtedly be made the means of lowering the cost of main products, and this will inevitably affect the pocketbooks of all of us while helping us to compete successfully with the foreigner, particularly in the field of world trade.

A vital example of multiple production in this country, in the realm of human food, has been furnished by the figures published by one of America's great packing concerns. With the average steer costing $84.45, and the average price received for the meat amounting to but $68.97, still, by reason of very close utilization of by-products, bringing in $24.09 per animal, it has been found practicable to realize a gross profit per steer of $8.61! Most of us are aware of the financial position enjoyed by these big purveyors to our creature wants. Similarly, large numbers of our other enterprises could be turned into industrial giants by a kindred adoption of multiple-production practices. Europeans are going to enjoy both quantity production and multiple production to put them on their feet again and to make them strong in the field of foreign commerce. Eventually, we must do the same: the sooner the better.

Some Phases of Reconstruction

(Continued from page 60)

The wind was succeeded by consuming fire. Again the prophet saw with the eye of his mind that his God was not in the fire. After the fire there came a still, small voice, and then the mind of the prophet knew he was in the presence of the Lord. We are not to mistake the noise of the bomb or the fire of the radical or the wind of the weekly editor for the voice of the American people.

The Lord in our story could speak in a still, small voice, for His was the consciousness of power, which needs not to be turbulent to be strong. The American people speak naturally with the quietness of conscious strength. While on the surface of their life the demagogue may rant, and the anarchist may proclaim, and the extremist, whether for capital or for labor, may shriek with equal futility, the thing we are to find, if we can, is what saith the still, small voice of America today concerning the great basic facts of work and industry?

That voice will not shout from the housetops. It will do its quiet work within the factory, large or small, where men are busy, where speeches are not made, and radical editors do not trouble. Believe me, just as sticks and refuse that float upon the stream are not evidence of its power, so the true currents of our own life lie deep and flow strongly and without noise.

This is what one who looks closely will see, unless I am deceived. Many there are that see it, and, as the prophet was comforted to find that he did not stand

(Continued on page 74)

THE successful farmer raises bigger crops and cuts down costs by investment in labor-saving machinery.

Good prices for the farmer's crops encourage new investment, more production and greater prosperity.

But the success of agriculture depends on the growth of railroads—the modern beasts of burden that haul the crops to the world's markets.

The railroads—like the farms—increase their output and cut down unit costs by the constant investment of new capital.

With fair prices for the work they do, the railroads are able to attract new capital for expanding their facilities.

Rates high enough to yield a fair return will insure railroad growth, and prevent costly traffic congestion which invariably results in poorer service at higher cost.

National wealth can increase only as our railroads grow.

Poor railroad service is dear at any price. No growing country can long pay the price of inadequate transportation facilities.

Out of accumulated capital have arisen all the successes of industry and applied science, all the comforts and ameliorations of the common lot. Upon it the world must depend for the process of reconstruction in which all have to share.

—JAMES J. HILL

This advertisement is published by the Association of Railway Executives

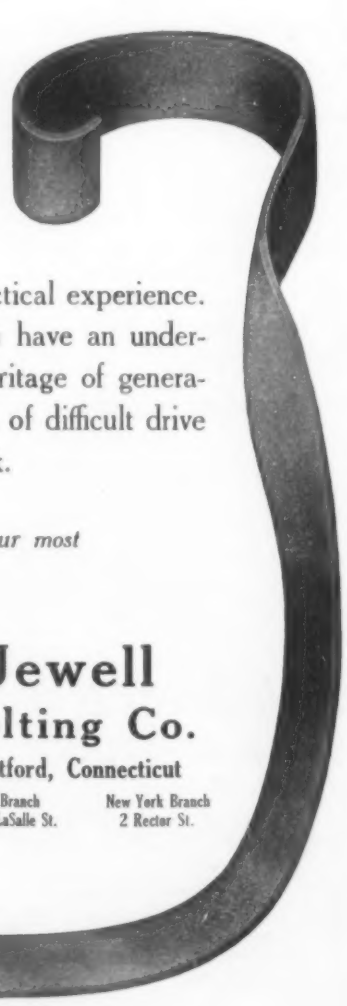
Those desiring information concerning the railroad situation may obtain literature by writing to The Association of Railway Executives, 61 Broadway, New York.

"It is less costly to buy a good belt than to suffer from a poor one"

Science has determined by rigorous tests that leather is the best material for power belting—that it slips less under heavy load, improves with age, and is more efficient.

This same knowledge the users of

Jewell Belting



have gained through years of practical experience. The men who make Jewel Belts have an understanding of leather that is the heritage of generations. In our business the solution of difficult drive problems has been every-day work.

Your inquiry will receive our most careful attention

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Hartford, Connecticut

Chicago Branch
2837 So. LaSalle St.

New York Branch
2 Rector St.

Some Phases of Reconstruction

(Continued from page 72)

alone, but that there were thousands with him, so those who look beneath the surface of things as they are reported today, find thousands in accord where some may have thought there were but tens.

Friendly Attitude of Industrial Leaders Toward Labor

We have seen the wages in American factories rise to a point above that at which they ever stood before. They still are at that height. Have you heard the voice of industry calling out that they should be reduced? Where is the industrial leader now found who argues in favor of reducing the wages of American labor? Is not the silence from a thousand industries more potent than the shrieks of a few agitators or the wails of a few employers? In their quiet way, which has no spoken voice that we can hear, the industries are moving on, little by little are taking up the slack. Steadily, as every financial authority states, the country is settling down to the assurance that matters are becoming stabilized. But they are not being stabilized because labor is being cut. They are being stabilized with the wages of labor standing where they are. Men who are leaders of great industries have consulted with me these weeks gone by; and everyone of them, without exception—not because of pressure, but from his heart and judgment—has agreed in urging that one inviolable thing, as matters are today, is the wage of the workingman. It seems to me that as we look out over the field of American industry and see this quiet acceptance of an absolutely new condition, not an acceptance from force but an acceptance arising from judgment and conscience, we see in it one of the silent voices of great power.

But this is not all that may be seen. There rises up in the Massachusetts Senate a member of that body who propounds and pushes to its passage a law—in conservative New England—whereby employees are given the right, under the organic law of the State, to elect directors of industrial corporations, who shall have all the right, privileges, and responsibilities of stockholding directors. Say you one further advance by labor advocates, one more victory of organized workmen? A victory indeed, but not so gained or so originating, for the author of this bill is the head of one great industry and active in the management of two others—industries that are known throughout the land—and he told me of the great satisfaction he had in thus being able to put into law the ideals that a long life as an employer had taught him.

In another part of the land, a thousand miles or more away, another great corporation, almost unnoticed, starts its operatives in a share of the company's management and rises to say that the plan has worked to satisfaction and for peace and for effectiveness.

The significance of these things does not lie only in the things themselves. It lies in the fact that men who are leaders of industry, of their own motion, out of their own experience and judgment, have themselves taken the forward step to bring them and their human fellows concerned with them in the same work into a position of more complete mutuality. Only a few days ago I talked with another large manufacturer, and his mind was occupied with the thought that it was a great pity industrial leaders had been so ill-advised, so slow to see that they had let labor take the progressive measures and had not themselves met them more than half-way, so that the leaders of capital in too many cases were forced into an attitude of resistance to demands which, being resisted, became aggravated, and to which in time here, there, and yonder they had, in a measure or in whole, to yield. So in a talk with a textile manufacturer, not long ago, he said to me that they had too long underpaid their people. It is plain to me—I think it will be plain to every thoughtful observer—that the most significant fact in industry today is the quietly avowed determination on the part of leaders of so-called capital to do their part, a larger part, not so much a generous as a just part, in getting together with the men with whom they work.

I have been inspired by meeting these so-called "hard-headed" men of affairs who have caught this vision of themselves as leaders of humanity, as men who wish the human relation to be the real and the potent thing in their industrial life, and who have been given the power to realize that out of this human relation all things may grow.

Fellowship of Employer and Employee to Displace Antagonism

Of course, we speak not as those who take their armor off, but as those who are putting it on. Of course, we have in capital and in labor the man of backward thought, him who does not see that the matter is passing beyond the discussion of the rights of capital and the rights of labor into the larger field of how brethren may dwell together in unity. One is quick to allege that labor is irresponsible; that it does not keep its contracts; that it is arbitrary; that it is not considerate; that it indulges in methods which are most inconvenient and hurtful, as he thinks, to the body politic. There is, no doubt, truth behind these statements, for men of labor and of capital are human, and, when forced to struggle for what seems to them right, neither has always been wholly free from error in the details of the contest. Speaking, however, as a manufacturer myself and wishing only to stike a balance of fair feeling, as well as of fair dealing, it is my strong impression that the errors of labor upon which some dwell are, in major part at least, but reflections of errors of capital, and that, if we come to a distribution of faults, it will be quite as easy to list them upon one side as upon the other. Never, however, until we get such a mathematical view of virtue as that two wrongs make one right, will any such summing up be profitable.

I recall an Irish contractor in the building trade at home whom I knew well for many years. One time I said to him, "Barney, how long is it since you had trouble with your men?" He replied, "Not since I have been in business, sir. Not for 30 years." I said, "Barney, there have been many strikes in the buildings trades in New York in that time. How do you get along with your men without them?" "Well," he said, "I try never to forget that I am just one of them myself." Barney was a strong, capable man. I suppose he could be called by some a capitalist. That may have been true; but there was no separation in his mind between himself and his men on that account.

Let us admit that all men are faulty and that mistakes are made by labor, as mistakes have been made by capital. Nevertheless, in this world each needs the other, and we must get along together somehow. To "get along" does not mean passive endurance by each of the other; but progress together. It means "going"; that implies motion—progress together.

Common Spirit in Industry an Outgrowth of Great War

We have just fought a great war. For what purpose? Not to make us rich or powerful or to extend our territories. Not for the purpose of enlarging our trade, but simply because there was hideous selfishness in the world that took such form and did such things that it became our duty to do what we could to destroy it. Those who were in the army on the other side say that there was in our

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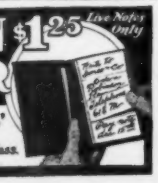

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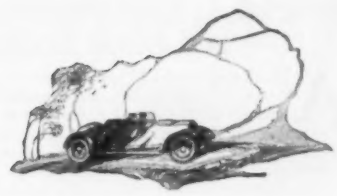
boys a wonderful spirit. It was formulated. They did not call it patriotism or religion. But it certainly was the spirit of sacrifice—of a tough job done at great risk that the world might be safe for our wives, mothers, sisters, and daughters, and that things generally might be cleaned up. Many of our boys from the mills, from the factories, and from all industries were over there, all with the same purpose. Their former bosses were many of them on the job—there and here—forgetting their earnings, ignoring their mills, putting their surplus into Government bonds, working without salary in the same cause. Thus, one common spirit was over all. Side by side in our drafted regiments were men of all sorts and conditions. The son of a cultured family in my old home led a group of East Side boys who spoke many tongues. Yet there was a common spirit. I think—I believe I am not mistaken—I think I have seen and heard it in the hearts and on the lips of men and in their deeds since. I believe that something of that common spirit has shed itself abroad, is shedding itself abroad throughout our industry; that in the mind and judgment of the leader is a more definite understanding of and sympathy with the man at the bench and machine; something a little more intimate, something a little more appreciative, something really more human. I think it is so. If it is so, it is the greatest thing that has happened to America—greater than the war, and infinitely worth the war.

What does this all mean, reduced to practice, for we are a practical folk, and we want to know whether this can be reduced to items of the day's work or not? First, I hope it means a more open mind between the industrial leader and the men whom he leads. I think it has meant already clear progress on the part of employers toward understanding the thoughts and the lives of the men they employ. Among the greatest arts of employment is that of getting at the other's viewpoint. Many of our troubles, whether trifling or large, come from a failure to understand what the other fellow wants, to comprehend just how he looks at things, and from the failure to understand that an aspiration which we have is not wrong when the other fellow has it. I think I have known men in certain positions to seek an increase in their own salary, while at the same time they would object to a workman looking for a dollar a day more. I know I have heard of superintendents who objected to continuing the piecework rate because the men, as he thought, earned too much. I have friends today who do not realize in their sincere arguing of the relative rights of capital and labor, and in their equally sincere effort to secure the rights of capital, as they see them, against what they regard as the encroachments of labor, that they are looking at the thing quite superficially from the standpoint of legality and controversy, whereas it is a matter which should be dealt with and only can be finally dealt with from the standpoint of a common spirit.

There have been 64,000,000 subscribers to our Liberty loans and as many as 20,000,000 to one loan. Surely the capitalist class is being extended. It must include many who do not recognize themselves by that label. I suspect that many a factory is manned, as I know some Government services are, by a force from top to bottom that are all capitalists in varying degrees, but none the less really.

Reconstruction is, after all, a state of mind, and upon our mental attitude as men toward one another, upon the ideals that guide us, upon the ideas we express, upon the way we express them, upon the doing in one or another way of the ordinary, daily tasks of life, depends the whole progress of our beloved country.

To you who drive motor cars



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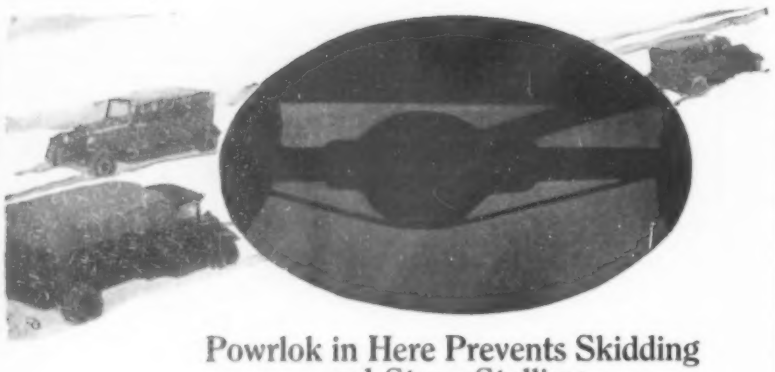

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The Alaskan Railways

(*Continued from page 62*)

field, sends its waters into Knik Arm; so that one must consider the Matanuska coal beds to belong to the southern side of the mountains. However the Nenana Coal Field is in the valley of the Nenana River which sends its waters north for ultimate discharge into the Yukon River; so that this coal region is to be assigned to the north side of the mountain range.

Naturally the railroad has, in order to penetrate to Fairbanks, to get through the mountains or round at one end. As a matter of fact, the route runs through them. That is to say, the line goes up the southern flank by following the course of the Susitna River back to a point where the river valley extends off to the east. The road crosses the Susitna at this point and follows, for a short distance, the valleys of the Indian River and of the forks of the Chulitna. All this portion of the road belongs to the south side of the range. Chulitna Pass and Broad Pass are points where the line may be said to cross to the north side of the mountains. The highest point on the line is in Broad Pass where an elevation of 2,319 feet is attained at a position 314 miles from Seward. The descent on the north flank of the range now begins. The route follows the valley of the Nenana River down to a point near the junction of this stream with the Tanana River which empties into the Yukon. The maximum elevation necessary for the passage of the mountains is moderate, when it is considered that peaks in the range run up to 16,140 feet (Mt. Blackburn), 17,100 feet (Mt. Foraker), 17,500 feet (Mt. St. Elias), and 20,464 feet (Mt. McKinley). The engineers responsible for the route of the Alaska Northern have found a very favorable combination of circumstances, in so far as the peak of the profile of the route is concerned.

The grades on the line never exceed 2 per cent and upon the greater part of the route the maximum is 1 per cent. All this seems to favor operation. The moderate grades made possible, in part, by the low elevation at Broad Pass, are to be regarded as of high importance in connection with all-year operation on a road whose southernmost point barely reaches down to the 60th parallel of latitude. It is fortunate, indeed, that there are no very steep grades through the mountains. If it were otherwise, operation would certainly have to be restricted to favorable seasons of the year. In fact, it yet remains to be seen whether midwinter operation is going to be successful.

We are not to get an exaggerated idea of the coldness of the climate of Alaska, particularly that part lying to the south of the Artic Circle. The parallel of latitude of 60 degrees, N., passes near Seward. But it also passes near or through Christiania, the capital of Norway, the university of Upsala in Sweden, and Petrograd, the capital of the former Russian Empire. Stockholm is but a few miles to the south. In fact, the larger part of the Shetland Islands, Norway and Sweden lie to the north of this parallel. So, one is not to consider sub-circle Alaska as some impossible region, merely because it is far to the north. It is not further north than other and civilized regions of the earth. At the same time, the winters are not balmy. The difficulties with snow encountered by the great transcontinental roads of northern United States and of Canada in crossing the Rocky Mountains in the winter are, doubtless, to be expected all through the mountain sections of the Alaska Northern Railroad. It is to be doubted whether the difficulties will turn out to be in any degree greater. The location is further north, but the elevation of the summit is very much less and the maximum grades are possibly lower.

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Whether the Government will ultimately use steam or electricity is probably still more or less undecided. The old road was operated by gasoline. With two coal fields tapped by the road, one would naturally expect that coal would probably be employed; but even so that would not decide between steam and electricity.

The coal in the Nanana district is lignite. This coal will probably be shipped north rather than south, for the reason that it may then be carried to points along the Yukon River and connecting steams by means of steamers and other craft. Southern demands will naturally be met by the Matanuska output. In fact, it seems to be a good thing for Alaskan development that plenty of coal is or will be shortly available on both flanks of the great mountain range. The availability of coal can hardly result otherwise than to promote settlement in both districts.

Some of the most difficult construction work of all that has been or will be required along the whole line from Seward to Fairbanks occurred in a tidewater section, strange as this may seem. This section is along the northern shore of Turnagain Arm. Frequent and precipitous rocky slopes reaching down to water occurred in the path of the advance. Despite the effort to avoid excavation by making fills and seeking other alternatives, some 1,120,000 cubic yards of rock were cut and blasted out, and about the same amount of soil. The rock was principally a hard slate, but there were some quarzite dikes. Heavy fills were constructed whose slopes ran down into the waters of Turnagain Arm. These fills must withstand the action of the heavy tides. Timber culverts and trestlework have been employed to a considerable extent to pass water courses and gullies. A number of the larger streams are crossed by truss bridges. The country is exceedingly irregular; so much so, in fact, that the expedient of using sharp curves in order to avoid heavy construction has not solved very many of the problems. It has been estimated that an aggregate length of a mile and one-half of snow sheds will be necessary to protect this part of the railroad from the slides and avalanches of snow. These frequently start from long distances back on the cleared mountain side.

The engineers and others are working under conditions of an incomplete knowledge of what Nature will and will not permit. For example, in the Fairbanks section near Nenana (414 miles from Seward, "The Nenana River left its channel, broke through Lost Slough, crossed complete grade, and caused numerous disastrous washouts, involving a number of miles of track. On account of this, it was necessary to make a change in the line, which was removed 2 to 2½ miles east of the original location." Still other damage was done by the flooded condition of the Tenana River. This lasted for about two weeks, right in what we would term mid-summer.

About 114 miles from Seward is the city of Anchorage. In 1917, it had a population in excess of 5,000. Such modern features as water works, sewers, fire stations, hospital buildings, and schools have already been added to the city, although these features may not be at all of an adequate character for the whole population.

Anchorage is at the mouth of Knik Arm as well as on the Alaska Northern Railroad. The railroad should make it possible to bring certain kinds of freight to the city *via* Seward at a less figure than it will cost to deliver them by an all-water route. The U. S. transport "Crook" put down freight, in 1917, at Anchorage at about $8 or $9 per ton, the point of origin being Seattle. At the same period, privately owned steamers charged about $20 per ton. Potatoes brought by the steamship companies to Anchorage from Seattle were put on the wharf for about $30 per ton. The temperature at Anchorage is said never to have fallen lower than 38 degrees below, Fahrenheit.

This city will doubtless do business with the outside world both by the stretch of railroad running down to Seward and by the water route through Cook Inlet. There are, however, difficulites connected with the all-water route. The tidal difference runs from 36 to 42 feet. At ebb and flow there is a current of about 8½ miles per hour. These conditions just as they stand mean considerable difficulty. But there is a notable complication. While the salt water of Knik Arm does not freeze, the fresh water of the streams emptying into it do. Blocks of ice 4 feet or more thick and up to 40 feet across collect above a narrow straight opposite Campbell Point. When the tide goes out, these settle on the mud. When the tide returns, they are lifted, but carry with them a considerable amount of mud. This settlement and lifting recur continually with the result that great masses of ice and mud form. These are then carried past Anchorage in the 8½-mile current, and naturally constitute a menace to shipping.

The Government proposes to meet conditions at the water-front of Anchorage by the construction of a wharf 80 feet high. The great height is needed to take care of the 42-foot change in the level of the water. This will give a minimum of about 6 fathoms of water at low tide. This wharf is to have a length of 1,000 feet. Wings are to be run obliquely back to the shore from each end of the wharf, each to be about 1,500 feet in length. The one mole is to have a top width of 50 feet and the other, of 20 feet. Both are to be protected by rip-rap on the exposed face and the narrower one on the inside face as well. All faces are to be on a 2-to-1 slant. The broad mole will be wide enough to carry three railway tracks of standard gage out to the coal bunkers on the wharf. Here Matanuska coal will be stored and delivery made to vessels. It will readily be understood that the provision of 6 fathoms of water at minimum low tide along the face of the wharf may call for considerable dredging. Some 400,000 cubic yards of ocean bottom are in fact to be removed. It is proposed to redeposit enough of this spoil to fill in an area back of the wharf of such size as to provide for the storage of 100,000 tons of coal. The plan is to devote one-half of the wharf to coal and one-half to other freight. Conveyors and electric cranes are to be installed, and loading and unloading may go on whether the tide is in or out. Protective barges loaded with rock are to be placed at the ends of the wharf to form arms extending obliquely out into Knik Arm. It is thought that the current along the face of the wharf will be reduced to about 2½ miles per hour.

Coal will be shipped from Anchorage rather than from Seward. The railroad haul will then be a small matter of, say, 75 miles. It is possible however, that some coal may be loaded on to ships and barges at Seward in the winter season. Anchorage is not the nearest tidewater point to the mines, but it is a point capable of development, being at the junction of Knik Arm with Cook Inlet. The summers are said to be mild, which one has no difficulty in believing. The winters are said to be "not severe." This latter is to be attributed to the close proximity of the Pacific Ocean. In the summer, it is always day, there being only a suggestion of our customary night in the twilights which intervene between the recurring full-light days. The country in the neighborhood is fine. The Alaskan range is always part of the scenery. If the day is clear and fine, one may discern 175 miles away, Mt. McKinley, whose snow cap reaches nearly 4 miles into the sky.

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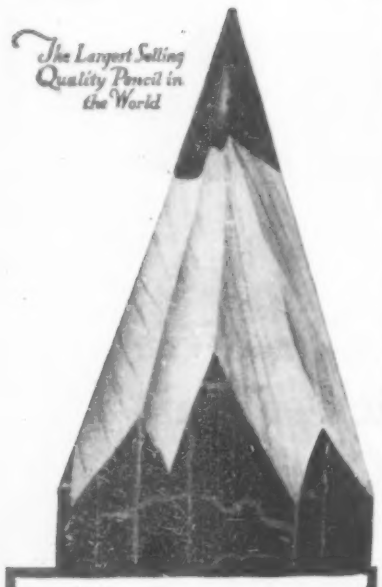

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Fighting the Auto Thief

(Continued from page 63)

a car, concealing from general view the fact that a wheel was locked, while one of their number actually jacked the car up, removed the balky wheel, and substituted another. In fact, the organized thieves are so clever that it sometimes seems as though the only protection against them is to trust in Providence, and try to catch them after they have got your car. As a matter of fact, much the same condition applies here as in house-breaking. The really skilled crook who is determined to get into your house can do so in the face of every precaution; but it pays none the less to lock the doors and windows to keep out the loafer and the sneak-thief. In the same way, it pays to fix your car up in such a way, when you leave it at the curb, that while the educated automobile thief may have little difficulty in getting away with it, it presents insuperable obstacles to the chance passer-by who sees it and is tempted. This can be done in a variety of ways, all of which aim at the same end—making it impossible to run the car until the owner comes back and fixes it so it will run. One way, and a very simple one, is to put the ignition out of business by putting the distributor arm in your pocket every time you get out of the car. Another stunt is to remove the cap of the gas tank, releasing the pressure and preventing the flow of the gas into the carburetor. And to the really competent driver there will occur a lot of other little tricks of one sort or another which he can play to foil the amateur car thief.

An All-Metal Biplane for All-Round Use

(Continued from page 63)

proved the capacity of the machine practically to fly itself.

It is fitted with a six-cylinder radial Anzani engine developing 45-50 horsepower. Its climbing capacity is moderate, it being possible to attain 5,000 feet in 8 minutes and 10,000 feet in 18 minutes. Its flying speed is 85 miles per hour, but the landing speed is only 30 miles an hour which is an attribute commending it to private civilian use. The builders have had considerable experience in airplane design and construction, war manufacturing performance having comprised the construction of 2,000 machines of various types including the S.E.5, single seater fighting scout which was popular among the American airmen, and over 2,500 engines. The "Whippet" is marketed at about $2,500 and the flights which have been made therewith have created favorable impression.—*F. A. Talbot.*

The Vacuum Tube—An Electrical Acrobat

(Continued from page 65)

Figure 3 shows a much used circuit devised by E. H. Armstrong and known as the "Regenerative Circuit." This method makes possible the simultaneous detection and amplification of the incoming signal by the use of a single tube. The explanation for this action is as follows: Consider Fig. 3, in which oscillations are received by antenna *A* and transferred to grid *G* by receiving inductances *P* and *S* through grid condenser *G.C.* This, as explained in the action of the detector in Fig. 2, will produce variations of the current supplied to the plate *P* by the plate battery "*B*." These plate current variations—rise and fall of oscillations—will therefore be re-transferred to the grid circuit by travelling through telephone condenser *C*, and regenerative-transformer inductances *L 1* and *L 2*. This has the effect of amplifying the grid oscillations to such an extent that they will in turn increase the rise and fall of the plate current, thereby greatly increasing the resulting sound in telephone receivers *T*.

Fig. 4 shows a radio circuit employing three tubes, number 1 as a detector of oscillations and numbers 2 and 3—through the intermediary of the audio-frequency iron-core transformers *T 1* and *T 2*—as two steps of amplification for the received signals. Two-step amplifiers are now in general use and are considered as giving a receiving amplification of 10,000 times. Additional steps up to ten stages, usually referred to as "cascade" amplification, have been used successfully, but such involved apparatus requires the most careful adjustment by experts.

The radio compass, which has been developed and brought to a high degree of perfection during the war, would hardly be out of the laboratory stage today were it not for V. T. amplification. This is largely due to the fact that the V. T. makes possible the reception and amplification of the extremely feeble oscillations picked up by the small capacity loop antenna.

As a Generator of High Frequency Oscillations

In addition to being an excellent detector and amplifier of radio signals, the V. T. may also be employed to generate the necessary oscillations for either radio telegraphy or telephony. Fig. 5 shows one method of connection capable of producing high-frequency oscillations. The condition which makes this possible is practically the same as that obtaining in the regenerative circuit, Fig. 3, and already explained in the theory of amplification. That is to say, if inductances *L 1, L 2, L3* and *L4* of Fig. 5 are properly coupled and the plate energy transferred back to the grid becomes greater than the initial grid energy, the resultant oscillations will remain in the system even if the condition which originally started the oscillation is eliminated. Thus a series of undamped oscillations is generated and the frequency may be controlled at will from one to possibly 20,000,000 cycles per second by the proper variation of inductance and capacitance. Vacuum tubes employed for this purpose, however, are of somewhat greater dimensions than the receiving tubes, since they must stand plate voltages ranging from 300 to 3,000, and in order to do this without causing undesirable operating conditions they must be subjected to a very high vacuum. Such transmitting tubes, usually known as "oscillions" or "pliotrons," are provided also with means of cooling, especially since their power output may reach one kilowatt or more. To secure additional power output, several tubes may be connected in parallel. In fact, there seems small doubt that this form of generating high-frequency oscillations will be used extensively in the future. Fig. 6 shows a simple circuit diagram of a V. T. in connection with a radio telephone transmitter, and is practically self-explanatory.

The V. T. as a Telephone Repeater

In its manifold applications to radio telegraphy and telephony, very few outside of those immediately concerned are aware that the V. T. plays an important rôle in the businessman's daily telephone conversations from New York to Chicago or Denver or San Francisco. The repeater, as applied to wire telephony, is an instrument placed at various intervals in long-distance telephone line, and is designed to reinforce telephonic currents which have become enfeebled in travelling through long stretches of wire. In this connection the vacuum tube is employed to repeat and amplify the telephone current fluctuations produced by the voice, and performs this in a manner similar to the amplification of radio oscillations. Not only this but by the use of vacuum tubes and special filter devices, multiplex telephony and telegraphy becomes a reality, where five or more telephone conversations in addition to a

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One rope hoists, lowers and holds the load
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Garco gets a hind leg hold on your brake drums that there's no getting away from.

It's as tough and strong as the muscles of a mustang. And it's got more endurance.

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Morse telegraph line are superimposed on one circuit.

Fig. 7 shows a schematic diagram of the method in which the V. T. may be connected as a telephone repeater and amplifier. In this circuit *T 1* is a step-up transformer, which transfers the incoming telephone current to the grid, *R* is a high resistance, *C* is a battery designed to make the grid negative, and *T 2* is a repeating coil which impresses the plate circuit variations on the telephone line.

Rectifier of A. C. to D. C.

The fact that the V. T. has the property of rectifying A. C. to D. C. as explained in its action as a detector, is made use of in the so-called "Kenotron" and "Tungar" rectifiers, which are specially constructed two-element tubes using filament and plate only. The "Kenotron" is employed for changing alternating currents of high voltage and low frequency to pulsating direct currents, while the "Tungar" rectifier is used commercially to rectify 120-volt alternating current to direct current of low voltage and amperage suitable for the charging of automobile storage batteries.

Future of the V. T.

The vacuum tube, in modified forms suitable for each individual requirement, will shortly play an important rôle in the electrical and radio fields. It is capable of performing many feats, a fact which suggests a wide range of future activities for this invention. At present it is particularly successful as applied to the art of communication, and the day is not far off when telephone, radio telegraph and cable distances will be doubled and trebled, to say nothing of other inventions which have not yet been fully developed and commercialized, such as transmission of photographs by wire, long-distance radio telephony, high speed cables and others.

A remarkable long-distance radiophone conversation, which is prophetic of future development, took place in 1915 between Washington, D. C., and Honolulu, or over a space of approximately 5,400 miles. In this feat, which has never been equalled since, and the exact details of which remain a Government secret, a battery of 310 vacuum tubes was employed to generate and modulate the radio oscillations for both the receiving and transmitting sides, the success of this experiment being due to the perfect frequency generated by this combination of tubes.

Realizing the possibilities of the vacuum tube as a radio transmitter, and the revolutionary changes it would bring about if made to replace the present spark system, several large electrical corporations are today spending enormous sums in research and development work; and what is more, the plan bids fair to become a reality.

Noise Makers of the Stage

(Continued from page 65)

This is a box filled with heavy material and mounted upon wheels which would make the flat wheels of the ordinary trolley car go mad with envy. The effect of musketry, *et cetera*, is obtained by "spanking" a leather pad. The effect is well known to all who attend "movie" performances.

The optical lighting effect is usually produced by means of a metal hood provided with a wire gauze screen to prevent fire, which holds five cups of powdered magnesium. A fuse is placed in each cup, which is connected independently to a portable switch box, so that one of the electricians can turn on the current, exploding one or more of the charges, so as to give the required effect.

The noise of ocean waves is produced in a number of ways. The best, perhaps, is to allow a few ounces of bird shot to roll around in a circular box of light

Those White Teeth

Ask People How They Get Them

All Statements Approved by High Dental Authorities

Millions of teeth are being cleaned in a new way. You see them everywhere—white, glistening teeth.

Ask about them. The owners will tell you, probably, that they use Pepsodent. They have found a way to fight the film which causes most tooth troubles.

Millions have already proved it. Leading dentists everywhere advise it. And over 6,000 new people daily write us for a 10-Day Tube.

Why Teeth Discolor

A viscous film forms on the teeth and coats them. You can feel it with your tongue. Modern dentists know this film to be the teeth's great enemy.

It clings to teeth, enters crevices and stays. The tooth brush does not end it. The ordinary tooth paste does not dissolve it. So it remains to do a ceaseless damage, until removed by cleaning in a dentist's chair.

Film is what discolors—not the teeth. It is the basis of tartar. It holds food substance which ferments and forms acids. It holds the acid in contact with the teeth to cause decay.

Millions of germs breed in it. They, with tartar, are the chief cause of pyorrhea. So, despite the tooth brush, all these troubles have been constantly increasing.

Now We Combat Film

Dental science, after years of searching, has found a way to combat film. Five years of careful tests have proved this beyond question.

The method is now embodied in a dentifrice called Pepsodent. It complies in all ways with modern dental requirements. And a 10-Day Tube of this tooth paste is now sent free to anyone who asks.

Let Your Mirror Tell

Make this free test. Look at your teeth now, then look in ten days. Let your mirror tell the story.

Pepsodent is based on pepsin, the digestant of albumin. The film is albuminous matter. The object of Pepsodent is to dissolve it, then to day by day combat it.

Science has lately made this method possible. Pepsin must be activated, and the usual agent is an acid harmful to the teeth. So it long seemed barred. But a harmless activating method has been found, so active pepsin can be every day applied.

Send the coupon for a 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how the teeth whiten as the fixed film disappears.

The results are quick and evident. They are all-important. You will never go back to old methods when you know them. For the sake of cleaner, safer teeth cut out this coupon now.

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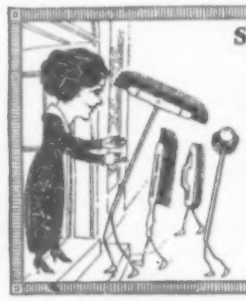

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wood lined with tin as shown in one of the accompanying illustrations.

Another device, which is extensively used even in the "movies" where these are produced on a large scale, is somewhat similar to the wind machine construction. It is called the "crash machine" and consists of a wheel with paddles set at an angle of forty-five degrees. Upon the top of the wheel one end of a stout piece of wood is pointed down by fastening the other end to a portion of the framework. When the wheel is turned, the slats passing under the stationary piece produce a rattling crash. The principle of the machine is illustrated by a boy running along a picket fence with a stick, allowing it to slip from picket to picket. In many theaters a gigantic rattle is used in place of a machine of this kind. This practice is largely followed by road companies who find it burdensome to carry much stage paraphernalia.

These various effects are of no value unless proper means are provided for giving the necessary "cues" to the stage operators.

Such are in brief some of the methods of producing stage illusions by sound. There has been little improvement in them in the last 50 years, and it really seems as though there is a field for some inventor to get up a universal sound machine the component parts of which could be operated from one central point.—*A. A. Hopkins.*

Patent Office Facts

(Continued from page 67)

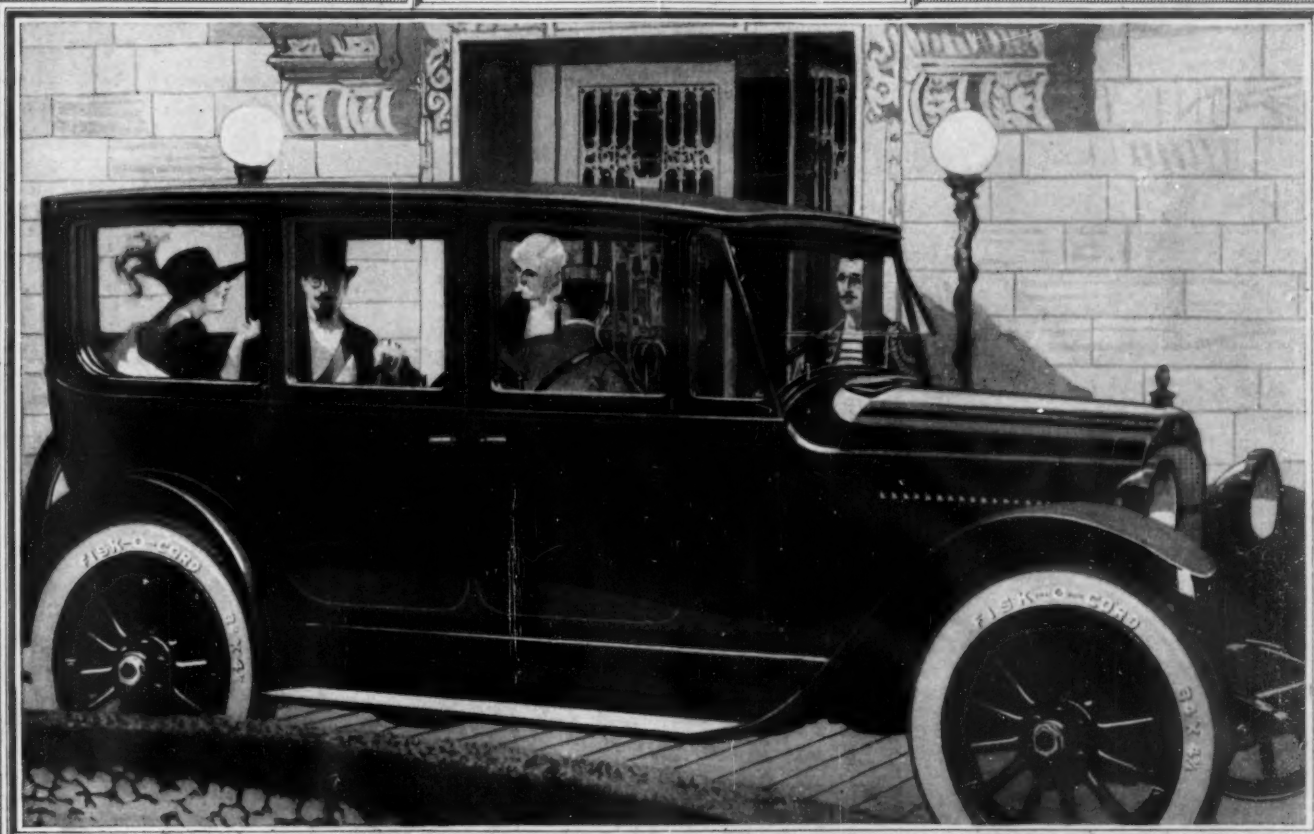
in order to determine what deeds are of record affecting the title of any patent or application, and the issue of patents must be examined weekly in connection with the title records to note the date and number of such patents on the records of such assignments and to insure a proper issuance of patents to assignees. Nearly thirty thousand writings are recorded annually, comprising transfers, grants and conveyances of inventions, including many agreements, licenses, mortgages, court orders or decrees, bills of complaint and other papers relating to title of patents. These are briefed for the "Digest of Assignments" so that one making a search under any particular invention may have a brief and thorough abstract of title. Work of this character requires a great deal of training and involves responsibility and special ability. It is very difficult indeed to replace any separations from the force in the Assignment Division, and yet within the past two years the turnover has amounted to one hundred per cent. There were before 1917, six or eight men in the division who were familiar with searching title. Today there are only three left who understand this work. In order to replace the losses in the Assignment Division, examiners' aids, and even copy pullers, young boys from the age of fifteen to seventeen, have been pressed into service with the hope that they may be trained in two or three years' time to become competent clerks. No wonder the division is two to three months behind in its work. And it is this division, by the way, the one that records millions of dollars' worth of patent property, which has been fitted out with the cast-off furniture of the Pension Office!

In Division F, which is the division of publication, the situation has reached a most critical stage. It is this division which furnishes copies of patents at five cents each to any one in the world who orders such a copy. The Patent Office undertakes to furnish a copy of any patent ever issued by this Government, for that small sum. The number of patents issued to date runs over 1,300,000. When a patent is issued 100 extra copies are made and filed by the Publications Division. The bundle of patents is held together by a canvas strap on which the number of the patent is written. After the first hundred copies of the patent are exhausted an order is put through for fifty more and thereafter patents are replaced in lots of fifty whenever they are exhausted. To accommodate all these patents requires *twenty miles of shelving!* And this length is increasing steadily every week, as new and more patents are issued. The shelves are to be found throughout the Patent Office, from the basement to the top floor. In many places there are tiers reaching up to the ceiling so that access to the patents is had only by climbing ladders or actually climbing up the shelves themselves. About eighteen thousand patents are ordered each day. To get the patents from the shelves calls for the work of a force known as "copy pullers." These, by Government regulation, are allowed a salary of $40 per month with a $20 war bonus, or a total of $60 per month. No competent help can be obtained for this price, except during the summer time when high-school boys may be prevailed upon to do some work during their vacation months. The Civil Service cannot supply any men and so the chief of the division has had to appoint emergency men from those he can pick up here and there. As a matter of fact, it is not men that he employs but mere boys. Most of the copy pullers are colored boys that have been picked up by the chief on the streets of Washington and induced to undertake the work. They are very unreliable as a rule, and have to be watched carefully by clerks of the division. At the present time sixteen thousand copies are pulled each day so that the department is going behind two thousand per day. Many large orders dating back to six or seven months have not yet been filled. In fact, at the time of our visit the division was 150,000 copies behind.

Aroused to the emergency of this situation Congress recently passed a bill authorizing the employment of ten additional copy pullers at the same rate of payment, and an increase in the charge for patent copies from 5 cents to 10 cents. While this measure is aimed to relieve the serious situation, the chief of the division is at a loss to know how he can obtain any more men when he has so much trouble now in maintaining the full quota of his force as authorized by previous government regulation. The only cure for a situation of this sort is an increase of pay so that a better quality of copy pullers may be obtained. Now, on account of the carelessness of the boys, bundles of patent copies are pulled out from the shelves and not replaced in proper order, or else allowed to drop on the floor. In climbing up the shelves they are sometimes broken. The packages of patents are packed so closely that it is very difficult to pull out a patent copy and replace the bundle in its previous position. The canvas bands get out of place so that the numbers on them do not show and it often requires a search to find a particular bundle. When copies of a patent become exhausted they are not always promptly reported, and there is much delay in replacing them. The system of filing is very crude indeed. This the division realizes and recently begged permission to install a steel case as an experiment in a new system of filing. But even the small appropriation asked for this steel case was denied. It is very obvious that the division cannot be run economically when copy pullers are required to travel all over the building, from basement to the top floor, in order to collect the patents ordered.

We have learned that since our personal investigation extra help has been obtained, and the copy sales situation is now somewhat improved.

It is clearly evident that the Patent Office needs more room. Every available square foot of space is occupied. The interesting and highly instructive Hall of Models had to be abolished several years ago.



Entrance, French Embassy, Washington, D. C.

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